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The Owners of British Patent No. 255453 for Process for CHEMICALLY VARYING VEGETABLE FIBRES, are desirous of entering into negotiations with one or more Firms in Great Britain for the purpose of exploiting the above Invention either for Sale of the Patent Rights or by the grant of a License or Licenses to Manufacture on Royalty.

Enquiries should be addressed to MESSRS. ABEL & IMRAY, 30, Southampton Buildings, London, W.C.2.

MASS NUMBERS OF THE CHEMICAL ELEMENTS, AND OBSERVATIONS ON ELEMENT FORMATION.

By F. H. LORING.

Dr. F. W. Aston in a Royal Society discussion on the structure of atomic nuclei, opened by Sir E. Rutherford (*Proc. Roy. Soc.*, 1929, *A*, 123, 372) asks why there are no elements having mass numbers 2, 3, 5, 8, etc., but no answer was forthcoming.

Mass numbers are the whole numbers which are close to the atomic weights of the individual atoms on the basis O=16. For example, hydrogen has a mass number of 1, but its atomic weight is 1.00777, or a value exceedingly close thereto. Helium has a mass number of 4 while its atomic weight is 4.00216, considered a very accurately-determined value; and, so on, with all other elements and their isotopes. The isotopes of argon have atomic weights of 35.976 and 39.971, while the corresponding mass numbers are 36 and 40 respectively.* This is all well known being now elementary knowledge, but the *why* and *wherefore* of the missing mass numbers remain unexplained in terms of extended knowledge.

If a series of values be worked out based upon the arbitrary equation exemplified *thus*—

$$2 \times 1/(2+1) = 0.\dot{6}$$
$$2 \times 2/(2+2) = 1.$$
$$2 \times 3/(2+3) = 1.2$$
$$2 \times 4/(2+4) = 1.\dot{3}$$

and so on—

it will be seen that there are *two* types of values so obtained. One type has *recurring* decimals, while the other has *not*, as in the examples above.

Working out 58 varieties of these it is found that there are only 10 which give simple values. All the others have recur-

* It is of passing interest to note that G. P. Baxter and H. W. Starkweather (*Proc. Nat. Acad. Sci., U.S.A.*, May, 1929, *15*, 441) have re-determined the atomic weight of argon and obtained the value 39.944 which is the mean of the masses or *atomic weights* of the argon isotopes as above given, when taking into account their proportionate number. This new determination is considered a truer one as the presence of hydrogen in small amounts was eliminated when carrying out the work.

ring decimals ranging from the first decimal figure repeating, as above, to groups of recurring figures, which in the case of $2 \times 57/(2+57)$ runs into 58 figures before the repeat begins.

Some interesting features are to be noted. The repeat is frequently of the type shown in the example: $2 \times 19/(2+19) = 1.\dot{8}0952\dot{3}$. Incidentally the number of digits in each repeating group, counting noughts, is usually even, and when so (with few exceptions) the sum of the decimal values, added horizontally, is the same when the group has the same number of digits in it.

Now if it be assumed that the simple value indicates that the progressive number in the equation which gives that value *cannot* be a mass number, then there is at hand a means of predicting missing mass numbers. A difficulty arises, however, for this exclusion rule breaks down in places.

For example, sodium has a single mass number of 23; but 23 by the above equation gives a simple value 1.84, instead of one with recurring decimals.

Harkins has pointed out that the elements having odd atomic numbers are the less abundant elements, as found in nature. Sodium seems to be an exception in this respect, as it is more abundant than its next-door neighbour, neon, which is of even atomic number.

If it be assumed that the neon atoms of mass 22 were once in great abundance (the equation is: $2 \times 22/(2+22) = 1.8\dot{3}$) but by some process they have captured hydrogen atoms, so that this abundant element is converted into sodium, which is widely distributed, then this difficulty is removed and $22+1=23$, this *not* being a *pure* mass number according to the view here developed, but representing a sort of exceedingly stable hydride.

This is interesting, for it will be remembered that Ramsay and Cameron in 1907-1908 attempted to transform atoms by the alpha particles or radiations given off from radioactive elements, in particular from radon (niton), and they concluded that neon and argon were produced from water and lithium from copper. Other experimenters were unable to reproduce these results. See STRUCTURE OF THE ATOM (1927), by Andrade, p. 73. Also J. N. Collie and H. S. Patterson apparently obtained neon by passing electric discharges through certain gases and bombarding calcium fluoride with cathode rays. Other experimenters on the whole failed to confirm this result. See ATOMIC THEORIES, by Loring, pp. 143, 144, where a summary of this work is given.

Now it is just barely possible that sodium, which is widely distributed like lithium, might yield neon under suitable conditions and the results of Collie and Patterson would seem to be explainable in this way—but see concluding part of this article.

Admitting this possibility, if such were the case, then the exception would prove the rule; and it is of interest to examine some of the other exceptions.

Lithium, according to this mass-number rule, should presumably have values 5 and 7, whereas, they are known to be 6 and 7. If, however, 5 took up a hydrogen atom, as in the case above, then $5+1=6$, and this explains the exception.

Nitrogen is exceptional, at least in some ways; *e.g.*, its valencies are 3 and 5, yet its mass or atomic weight is 14. It would seem more natural for nitrogen to have isotopes of mass numbers 13 and 15, so that here again a similar process may have operated, as, according to the rule, 14 gives a simple number and not one with recurring decimals as in the case of 13. Then $13+1=14$, as above. If this is so, then there may be a rare nitrogen isotope of mass number 15, and also a remnant of mass number 13.

According to this rule oxygen should have, besides 16, an isotope of mass number 17, but not one initially 18. See in this connection W. F. Giaque and H. L. Johnston, *Nature*, June 1, 1929, 123, 831; *Journ. Am. Chem. Soc.*, May 1929, *51*, 1436. These authors claim that they have evidence of the existence of isotopes of oxygen of mass numbers 17 and 18 from spectroscopic band interpretation. Kirsch and Pettersson (*Ark. f. Mat. Astron. och Physik*, 1925; *Phys. Zeit.*, 1925, 26 457) had reported an oxygen isotope of mass 17. These atoms are in such exceedingly small relative quantities that they would seem best described as *remnant isotopes*.

If remnant isotopes exist, then the few gaps may ultimately be filled, that is to say when such isotopes are discovered. Their quantities would be so small, however, that some subsidiary process may have formed them, or it may have been the cause of their diminution, as distinct from the action of the original process, whatever that may have been. See Blackett, *Proc. Roy. Soc.*, 1925, *A*, *107*, 349.

It will be seen from this study that in considering mass numbers two or three distinct processes may have been in operation,

but according to the above rule (for numbers from 1 to 58 inclusive) the following *pure* mass numbers should *not* exist:—2, 3, 6, 8, 14, 18, 23, 30, 38, 48. The three processes are (1) the original one as above indicated, (2) the hydrogen absorption, and (3) the Blackett process, if it may be so described.

In considering the above method of studying isotopes in connection with element formation, it is well to remember that Rutherford has driven hydrogen atoms from nitrogen atoms, to name a well-known outstanding example. Also that mass numbers, like atomic numbers, may be very important, and that the properties of the atoms are the properties of numbers. Perhaps the problem is to interpret these numbers. At the same time, it is necessary to realise the possibility, indeed the probability, that in the experiments showing the apparent production of helium and neon this was due—to some extent at least—to an in-leakage from the atmosphere through *thin glass, hot glass, flaws in the glass*, and *joints*, as in the taps, to cite the causes in question, apart from initial occlusion of inert gases.

An article on the detection of helium and neon and the passage of helium through glass, joints, etc. (by A. C. E.) appears in *Nature*, June 8, 1929, *123*, 879. This article should be read along with the paper by Collie and Patterson (*Chem. Soc. Trans.*, 1913, *103*, 419) describing the experiments referred to above. See also references below.

While the consensus of opinion will undoubtedly favour the later work, as cited in A.C.E.'s article, as rendering improbable element synthesis in early experiments, still the most conservative and critical observer can only express an *opinion* on the events which happened millions or more years ago. The view here given, as based on numbers, is retrospective.

The energy necessary to resolve sodium into its generators, according to the above view and the modern view of the atom, would certainly be greater than that applied in the vacuum-tube experiments cited.

It will be seen that this article suggests that with sufficiently powerful discharges neon could be made from sodium.

In addition to the citations above and the references therein the following early work may be studied:—Appearance of Helium and Neon in Vacuum Tubes, Collie and Patterson, *Nature*, 1913, *90*, 699; A. Fowler, *Nature*, 1913, *91*, 9. Presence of Neon in Hydrogen after the passage of the Electric Discharge through the latter at Low Pressures, Collie and Patterson, *Proc. Chem. Soc.*, 1913, *29*, 217. Production of Neon and Helium by the Electric Discharge, Collie, Patterson, and I. Masson, *Proc. Roy. Soc.*, 1914, *A*, *91*, 30.

As a final note, the decimal place could be shifted so as only to have *whole numbers* and *fractional numbers* in the above scheme.

THE MAGIC MEDICINE OF THE HOTTENTOTS.

By P. W. Laidler, L.R.C.S & P., D.P.H., F.S.A. (Scot.),
Medical Officer of Health, East London.

(Abstracted from the *South African Journal of Science.*)

(*Continued from page 406.*)

Toxicology.

The snake stone has been a famous antidote in all countries. The South Africans imported them from India, but few farmers could afford to purchase this remedy because of the expense. Barrow examined specimens and pronounced them to be pieces of firm bone charred round the edges leaving a white speck in the centre. When thrown into water, a snake stone caused bubbles to rise and this test was a proof of genuineness. It adhered to the snake bite, sucked out the poison, and was cleansed by soaking in water which it turned blue. Country people believed that it was obtained from the head of a snake. The snake stone of the Hottentot is quite a different matter, though it also is believed to be part of a snake. A young Richtersvelder gave this description: "I saw a snake's light. If you see it afar off it looks like a person's fire, but I know that there are no people there. Go nearer, and then it is seen that the light walks about. Then I keep away. I have heard that if a snake's hole be closed with earth that the snake then bites himself to death. Next day the snake stone is found in front of the hole where he dropped it when he went away."

Sam, two hundred miles south of the last informant, says that at night a twinkle is seen on the ricks, and that is a snake stone; and it is seen because the snake is away at the river. Then, to procure the snake stone it is necessary to keep a good look-out, and to approach cautiously with a handful of beast dung, which is to be thrown so that it puts out the light. Thereupon the absent snake becomes blind and cannot see, and can only creep aimlessly to and fro. Next day the dung is picked up and the snake stone, which is the snake's strength, taken away. He is ordinarily a strong-tempered

fellow, but after losing his stone he becomes weak, and cannot sit up to bite. The stone is used by the Natives together with bush medicines for poisonous swellings. Probably it is one of the numerous quartz crystals, loose or embedded in the rocks, which occur in profusion all over Namaqualand, and that reflect light at evening time.

Jacob Klaas, whose father was a full-blooded Nama, is the Poison Doctor for the Northern portion of Namaqualand. He learned his profession from his father, who in his turn had been taught by his father. He states that a boy must be strong to begin with, that is, he must have a good constitution. His father made two small cuts above the elbow of each arm, and into them rubbed a small portion of the dried venom of the cobra and night adder. Two weeks later his father prepared a lump of venom that contained several varieties, and gave him a piece to hold upon his tongue until he felt "funny and shivery." This was repeated twice weekly. Then he was given a piece to swallow. The dose was increased daily until the size of a pin's head was reached. Though now about forty years old, Jacob still takes his daily dose. The only venom not used in this process is that of the puff adder, because his father told him that it rots the flesh.

The treatment that this man adopts for bites of the cobra is incisions over the bite; he then places a piece of venom in his mouth and proceeds to suck the wound. He also gives the patient a small dose of prepared venom to be swallowed, which he says, congeals the poison inside so that he vomits it out. Puff adder bites he treats similarly.

Jacob catches snakes by breaking their backs and so paralysing them; they must not be killed. The head is fixed with a forked stick, after which the snake may be picked up by the back of its neck. The sacs of poison are carefully dissected out, each intact with its fang, from beneath the eyes. The sacs are ligatured at the base of the fangs to prevent the escape of venom. They are then hung up to dry. They are not mixed. Jacob uses no bead cloth, and therefore scrapes the greasy, sweated band of his old hat and mixes this with water to give to the patient. This internal dose is given only when it is seen that the poison "has got to the heart," and is given, as is the venom, to congeal the injected venom. Either the sweat or the venom will do, both have the same action. He also uses Bo Meester, and gives this drug internally for as long as the patient may be ill, and applies Black Klipsweet or Dassiepis plasters externally. One other old snake catcher gave me exactly the same information.

The gecko lizard, the D/ung D/ung, is by all, black and white alike, credited with being deadly poisonous. The only poisonous lizard has its habitat in Mexico; but Jacob dissects out some gland and uses it in the same manner as the venom sac of the snake.

Another Poison Doctor explained his immunity thus; after eating poison the snakes smell the man, do not like him, and run away from him, therefore, spittle and sweat are curative. (The Dutch used to give high prices for pieces of Poison Doctor head cloths.) Here, once again, the sympathy becomes apparent.

In a country that Nature has cursed with multitudes of snakes, spiders, and scorpions, cures and antidotes for their bites naturally form a large section of the folk medicine. Kabroo, a potato-like root, sweet to taste, is used raw, in slices, applied wet to the wound to draw out the poisou. Yellow Kafir wood, ground, is used as a poultice. This appears to have a certain caustic action. The crushed head of the snake may be applied as a poultice to snake bite. Bo Meester may be rubbed into scarifications over the bites. Powdered spider or tarantula is used as a poultice over their bites. In the case of scorpion sting the particular animal if possible is captured, its tail pulled off, also its noppers, the body is ground and applied as a paste. In each case of scorpion sting that the writer has treated, the body of the scorpion always accompanied the patient. On the spot where a snake has lived for many years, the Natives say, a slimy patch develops that is almost cement-like. This is used as an antidote for all poisonous bites, and is also given to dying people.

Abstract of Hottentot Herbal.

In discussing the various herbs used by the Hottentot medicine man, the following plan has been adopted :—

The Nama name is first given for the purposes of reference, then, in some cases, reference by travellers or other observers, and when modern uses are discussed the Nama name (if known), the Afrikaanse name and the scientific name are given.

Medicines.

Kanna. Kanna is a Salsola, of which there are several species. *Graevenbroeck* mentions that it was used similarly to hemp, and that the leaves were roasted in ashes and used as food. Paterson states that a certain district around the Kromme River

was called Channa by the Hottentots because of the quantity of the plant which grew there.

Namaquas in 1662 accepted presents from the Dutch, and in return gave fat-tailed sheep and Kanna, which the Commander pronounced to be similar to the Chinese Ginseng. The Cape root was scarce and was considered valuable, and possibly is the channa mentioned by the traveller Paterson in 1779. During the early days of the settlement at the Cape, a Hottentot would perform any task willingly if he knew that the reward was to be a piece of kanna. It would appear that certain of these writers confuse the root ningin or kanna with kaawgoed, the leaves of a Mesenbryanthemum, because they described properties which are certainly those of the latter. It was chewed and retained in the mouth for a while, when their spirits would rise, eyes brighten, and faces take on a jovial air, and they would commence to dance. But if indulged in to excess it robbed them of their senses and they became intoxicated.

Kauwgoed, *Mesembryanthemum tortuosum.* Leaves chewed for toothache and pains in the stomach. Has a strong narcotic effect due to alkaloid, mesembrine. Will make a child sleep. Used to-day for sand in horses.

Slaai, *Mesembryanthemum Crystallinum,* Nama N/nhoo or N/nghoop, is used for taking hair off skins, and is still in use among farmers.

Karremoer, *Mesembryanthemum stellatum.* One of the beer-making roots, a deliriant and intoxicant with an earlier stimulant action.

Krampsiekbosch, *Cotyledon Walchii* or *Lessertia annularis.* Stem is pounded and used for poultices on abscesses after spine and bark have been removed. When dry has somewhat the appearance of ginseng.

Buchu barosma, Letulina. Nama Sab (Tyndale . P/nkaou (name given to writer). Two varieties known in Nama as D/nhora, D/khonsa or Haas buchu, and P/kabourie. Considered by Hottentot to possess great virtues in curing disorders, and rarer forms are valuable to the Native. In powder used for dusting, for fire and sunburns. Baby powder made of D/nhora kept in tortoise shell puff box, roasted with fat and dropped in ear for earache. Powder also mixed with C/ghoonabi, an acacia thorn sucker, and then considered a high class powder. The second rate powder used for babies was mixed with ground acacia thorn bark, and is named O/kai. D/nhora Buku is roasted with oil and fat, mixed with mother's milk and dropped into the ear for earache. P/nkaou is rare and valuable, and a thimbleful is worth from a sheep to an ox. It is obtained in mountainous districts and when used is pounded and tied in a cloth over which hot water is poured. Is this a method due to exercise of economy?

P/thon daneep, or sweet honey, a sticky soft-leaved sweet tasting plant, is also used for powder making.

The thorn tree sucker was put to many uses. The Bushman used its ashes to blacken his face. To-day an oil not unlike cajuput is expressed and used for rheumatic troubles.

Xghoria or Xhoua, which means "smells strong," is a plant so far not identified. The whole plant is ground up and strewed on dead bodies, and is also applied to the living body when it has an unpleasant odour. This powder is also used as a snuff to keep away the smell of the dead "so that it doesn't strike in."

Bitter Roots. Many roots are known to-day under the name of bitterbosch, or bitter wortle, that is, bitter bush or bitter root. The chief are the blue bush, *Royena pallens, Xysmalobium undulatum (Asclepias crispa?)* and the Sand Bitter houd, a tall bush found in the mountains. These are so much used by the present white population that the Afrikaanse name has quite ousted the Nama one. The blue-bush root is also known as the black root, the wonderful emetic-purgative. These roots are powdered and boiled, and the decoction is used for pains in the stomach; if used for diarrhoea, then the stems of the plant are included. The liquor so prepared is greenish in colour and is exceedingly bitter, with a *Nux vomica* type of bitterness.

Dagga. Two species are recognised; wilde dagga, *Leonotis leonuris;* and klip dagga, *Leonotis ovatis.* Graevenbroeck mentions its use. The powdered leaves, he said, were made into a little cake no bigger than a Rijksdaler, a coin about the size of a modern shilling, which the Hottentots chewed, even as the Indians and Chinese chewed opium. In 1750 its use, mixed with tobacco introduced by the Europeans, is mentioned. A decoction of the reeds is used for headaches and for bronchitis. An ointment made from raw fat and pulverised dagga leaves is used for pains in the eyes. Its growth for commerce is now prohibited by law. It is still used with tobacco for smoking. A decoction of seeds boiled and allowed to stand is used for bronchitis and headaches.

X-RAY AND RADIUM PROTECTION.

Recommendations Adopted by the Second International Congress of Radiology, July, 1928.

(*U.S.A. Bureau of Standards Circular 374.*)

The dangers of over-exposure to X-rays and radium can be avoided by the provision of adequate protection and suitable working conditions. It is the duty of those in charge of X-ray and radium departments to ensure such conditions for their personnel. The known effects to be guarded against are : (*a*) Injuries to the superficial tissues, (*b*) derangements of internal organs and changes in the blood.

Working Hours, etc.

The following working hours, etc., are recommended for whole-time X-ray and radium workers :

(*a*) Not more than seven working hours a day.

(*b*) Not more than five working days a week. The off days to be spent as much as possible out of doors.

(*c*) Not less than one month's holiday a year.

(*d*) Whole-time workers in hospital X-ray and radium departments should not be called upon for other hospital service.

General X-Ray Recommendations.

X-ray departments should not be situated below ground-floor level.

All rooms, including dark rooms, should be provided with windows affording good natural lighting and ready facilities for admitting sunshine and fresh air whenever possible.

All rooms should be provided with adequate exhaust ventilation capable of renewing the air of the room not less than ten times an hour. Air inlets and outlets should be arranged to afford crosswise ventilation of the room.

All rooms should preferably be decorated in light colours.

X-ray rooms should be large enough to permit a convenient layout of the equipment. A minimum floor area of 250 square feet (25 square meters) is recommended for X-ray rooms and 100 square feet (10 square metres) for dark rooms. Ceilings should be not less than 11 feet (3.5 metres) high.

A working temperature of about 18° C. (65° F.) is desirable in X-ray rooms.

Wherever practicable the X-ray generating apparatus should be placed in a separate room from the X-ray tube.

X-Ray Protective Recommendations.

An X-ray operator should on no account expose himself unnecessarily to a direct beam of X-rays.

An operator should place himself as remote as practicable from the X-ray tube. It should not be possible for a well-rested eye of normal acuity to detect in the dark appreciable fluorescence of a screen placed in the permanent position of the operator.

The X-ray tube should be surrounded as completely as possible with protective material of adequate lead equivalent.

The following lead equivalents are recommended as adequate :

X-rays generated by peak voltages Not exceeding—	Minimum equivalent thickness of lead mm.
75 kv	1.0
100 kv	1.5
125 kv	2.0
150 kv	2.5
175 kv	3.0
200 kv	4.0
225 kv	5.0

In the case of diagnostic work, the operator should be afforded protection from scattered rays by a screen of a minimum lead equivalent of 2 mm.

In the case of X-ray treatment the operator is best stationed completely outside the X-ray room behind a protective wall of a minimum lead equivalent of 2 mm. This figure should be correspondingly increased if the protective value of the X-ray tube inclosure falls short of the values given in the table above. In such event the remaining walls, floor, and ceiling may also be required to provide supplementary protection for adjacent occupants to an extent depending on the circumstances.

Screening examinations should be conducted as rapidly as possible with minimum intensities and apertures.

The lead glass of fluorescent screen should, if necessary, be provided with a protective " surround " so that adequate protection against direct radiation is afforded for all positions of the screen and diaphragm.

Screening stands and couches should provide adequate arrangements for protecting the operator against scattered radiation from the patient.

Inspection windows in screens and walls should have protective lead values equivalent to that of the surrounding screen or wall.

Efficient safeguards should be adopted to *avoid the omission of a metal filter in all* X-ray work.

Protective gloves, which should be suitably lined with fabric or other material, should have a protective value not less than ½ *mm. lead throughout both* back and front (including fingers and wrist). Protective aprons should have a minimum lead value of ¼ mm.

Electrical Precautions in X-Ray Rooms.

The floor covering of the X-ray room should be insulating material, such as wood, rubber, or linoleum.

Permanent overhead conductors should be *not less than 9 feet* (3 m.) from the floor. They should consist of stout metal tubing or other coronaless type of conductor. The associated connecting leads should be of coronaless wire kept taut by suitable rheophores.

Wherever possible earthed guards should be provided to shield the more adjacent parts of the high-tension system. Unless *there are reasons to the* contrary, *metal* parts of the apparatus should be efficiently grounded.

The use of quick-acting double-pole circuit breakers is recommended. Overpowered *fuses should* not be used. *If more than one* apparatus is operated from a common generator, suitable overhead multiway switches should be provided.

Some suitable form of kilovoltmeter *should be provided to afford a measure* of the voltage operating the X-ray tube.

Radium Protective Recommendations.

(a) *Radium Salts*—

Protection for radium workers is required from the effects o :

(*a*) Beta rays upon the hands;
(*b*) Gamma rays upon the internal organs, vascular and reproductive systems.

In order to protect the hands from beta rays, reliance should be placed, in the first place, on distance. The radium should be manipulated with long-handled forceps, preferably made of wood, and should be carried from place to place in long-handled boxes, lined on all sides with about 1 cm. of lead. All manipulations should be carried out as rapidly as possible.

Radium, when not in use, should be stored in a safe as distant as possible from the personnel. It is recommended that radium tubes or applicators be inserted into separate lead blocks in the safe, giving a thickness of protective wall amounting to 5 cm. of lead per 100 mg. of radium element.

A separate room should be provided for the "make-up" of screened tubes and applicators, and this room should only be occupied during such work.

In order to protect the body from the penetrating gamma rays during handling of the radium, a screen of not less than 1 inch thickness of lead should be used, and proximity to the radium should only occur during actual work, and for as short a time as possible.

The measurement room should be a separate room, and it should contain the radium only during its actual measurement.

Nurses and attendants should not remain in the same room as patients undergoing radium treatment.

All unskilled work or work which can be learned in a short period of time should preferably be carried out by temporary workers, who should be engaged on such work for periods not exceeding six months. This applies especially to nurses and those engaged in "making up" applcators.

Discretion should be exercised in trans*mitting radium salts by post. In the* case of small quantities it is recommended that the container should be lined throughout with lead not less than 3 mm. thick. It is more satisfactory to transport large quantities by hand in a suitably designed carrying case.

(b) *Emanation.*

In the manipulation of emanation, protection against the beta and gamma rays has likewise to be provided.

The handling of emanation should be carried out, as far as possible, during its relatively inactive state.

The escape of emanation should be very carefully guarded against, and the room in which it is prepared should be provided with an exhaust fan.

Where emanation is likely to come in direct contact with the fingers, thin rubber *gloves should* be worn *to avoid contamina*tion of the hands with active deposit. Otherwise, the protective measure recommended for radium salts should be carried out.

A separate pumping room should be provided with a connecting tube from the special room in which the radium is stored in solution. The radium in solution should be heavily screened to protect people working in adjacent rooms. This is preferably done by placing the radium in solution in a lead-lined box.

There were 405 plants in operation in 1928 in the manufacturing of non-ferrous metals, including smelting and refining. Although the number of plants shows little change from the previous year when there were 401, the number of employees increased by nearly 2,000 to a total of 35,407 while the amount paid out in salaries and wages increased by over $8,000,000, to an annual payroll of $47,358,864.

Capital employed in these industries shows a remarkable advance to $249,391,088, as compared with $208,957,166 in 1927, while the net value of production, or the value added to raw materials by manufacturing amounted to $138,592,600, as compared with $112,757,295, in the previous year. The cost of raw materials used was $97,843,758 in 1928, as against $87,612,666 in the previous year.

Over the five-year period covered by the statistics furnished in the Report, the number of plants engaged in non-ferrous metal manufacturing has increased from 350 to 405; capital increased by 38 per cent.; number of employees by 30 per cent.; value of payroll by 38 per cent.; cost of materials by 56 per cent.; selling value of products by 75 per cent.; and the value added by manufacturing processes by 91 per cent.

There was a substantial gain in production value during 1928 in each of the 7 industries classified. The rise in the *non-ferrous smelting and refining industry* was especially noteworthy. The greatest advance was recorded by this group of plants, in which production totalled $94,841,702 in value, as against $77,996,265 in 1927. The same ten concerns were in operation and although the number of employees was slightly lower at 7,526 compared with 7,671 in the previous year, they handled ores valued at $33,260,225 compared with $32,516,687 in 1927, and the net value of production, or value of shipments less the cost of ores, concentrates, matte, etc., treated rose to $61,081,477 from $45,479,578 in the previous year. A remarkable expansion in the facilities for non-ferrous metal smelting and refining is indicated in the increase in capital employed, which amounted to $120,085,742 at the close of 1928, as compared with $85,366,662 the previous year.

Another important group of industries included in the Report is the *electrical apparatus and supplies industry*, which also showed a splendid gain with an output valued at $92,487,827, as compared with $78,558,730 in 1927. The number of establishments rose from 180 to 185, and the number of employees was 18,154, or 8 per cent. more than the previous year. Capital rose from $80,475,999 to $84,190,790; cost of materials from $32,734,875 to $37,958,986; and the net value of manufacturing from $45,823,855 to $54,528,841.

While the electrical apparatus and supplies industry gained a great deal of business from the large amount of construction work in Canada, the Report also indicates very substantial increases in production in other branches of the non-ferrous metal industry. The output of the *brass and copper industry* in 1928 was valued at $28,081,586, a gain of 17 per cent. over the 1927 figure of $24,054,657. Although the number of plants decreased from99 to 97, the number of employees increased from 4,882 to 5,298; the amount of capital employed rose from $22,425,179 to $23,362,157 while the net value of production amounted to $12,601,924, as compared with $11,507,939 in 1927.

Aluminium products were worth $3,192,696, or 38 per cent. above the figure for 1927; *precious metal products* advanced 3 per cent. in value to $11,722,548; *lead, tin and zinc products* were valued at $5,503,360, or 7 per cent. more than in 1927; and *miscellaneous non-ferrous metal products* were valued at $1,106,639, or 17 per cent. above the figure for the previous year.

PATENTS COMMITTEE, 1929.

Board of Trade Announcement.

The Patents Committee, under the chairmanship of the Rt. Hon. Sir Charles Sargant have begun their investigations; and persons and associations who wish to submit suggestions or to give evidence before the Committee are invited to communicate with the Secretary, Mr. R. W. Luce, Industrial Property Department, Board of Trade, 25, Southampton Buildings, W.C.2.

The Committee were appointed by the Board of Trade to report whether any amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office, are desirable.

SURVEYING IN ALBERTA.

The geological survey party which is to make a survey of mineral resources in the northern part of the Province of Alberta under the direction of the Provincial Government started out recently for their summer's work. The survey will be facilitated by the use of photographs of the area to be

covered, which were taken last year by the Dominion Government air photographers.

In addition to the two soil survey parties which have already gone north, a third party has gone to the area east of Lesser Slave lake, where comprehensive investigations of soil types will be made.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Papers read on Thursday, June 27 :—

A Photoelectric Method of Measuring the Light of the Night Sky : with Studies of the Course of Variation through the Night. By LORD RAYLEIGH, F.R.S.

The Action of High-Speed Cathode Rays on Acetylene. By J. C. McLENNAN, F.R.S., M. W. PERRIN, AND H. J. C. IRETON.

Fluorescent and Phosphorescent Excitation of Mercury Vapour by the Resonance Frequency and Lower Frequencies. By LORD RALEIGH, F.R.S.

Further Studies in the Emission of Electrons from Cold Metals. By T. E. STERN, B. S. GOSLING, AND R. H. FOWLER, F.R.S.

This paper extends the previous work of Nordheim and Fowler on electronic emission from clean cold metals to cold metals with surface films. It is found that a consistent and satisfactory account can be given, in the light of this extension of the theory, of a rather wide range of experimental results, in particular numerous results (some not hitherto published) obtained by one of the authors in the Research Laboratories of the General Electric Company. Most of the films concerned in these experiments were known to be of sodium (or tungsten), and it is shown that the normal stable sodium film formed is mono-molecular and reduces the work function from 4.5 volts to somewhat less than 2 volts. The currents concerned are of high density and the space charge correction is therefore investigated and shown to be negligible for the conditions of the experiments discussed. The experiments are analysed so as to derive the area of the emitting spot and its sharpness as measured by the local enhancement of the field. The theory yields satisfactory values for the quantities.

Papers read in title only :—

The Stress Produced in a Semi-Infinite Solid by Pressure on Part of the Boundary. By A. E. H. LOVE, F.R.S.

The Ageing of Standard Cells : Increased Accuracy in their Use : and International Comparisons. By A. N. SHAW AND H. E. REILLEY AND R. J. CLARK. Communicated by A. S. Eve, F.R.S.

A Comparison Between the Behaviour at the Ac_3 Point of Single Crystal Iron and Polycrystal Iron, both in the Strained and Unstrained States. By H. QUINNEY. Communicated by G. I. Taylor, F.R.S.

An Electrometric Method for the Determination of Ozone at High Dilutions. By J. N. PRING AND G. M. WESTRIP. Communicated by Sir Ernest Rutherford, P.R.S.

High-Frequency Fatigue. By C. F. JENKIN AND G. D. LEHMANN. Communicated by Sir Richard Glazebrook ,F.R.S.

Ionisation by Collision in Monatomic Gases. By J. S. TOWNSEND, F.R.S., AND S. P. MACCALLUM.

The authors comment on some recent theories of conductivity for which general acceptance has been claimed. It is shown that many simple phenomena would be inexplicable if the hypotheses involved in these theories were applied to the whole experimental field.

The Structure of the High Pressure Carbon Bands and the Swan System. By R. C. JOHNSON AND R. K. ASUNDI. Communicated by T. R. Merton, F.R.S.

The production and origin of the High Pressure Carbon system and the Swan system are discussed. Both these systems are due to a C_2 molecule. Four new H.P. bands have been found in the near ultraviolet, and two more in the near infra-red. These, with the known bands, form a singlt vibrational progression ($n'=0$), and the H.P. system and the Swan system are found both to represent transitions to a common final state.

Gaseous Combustion at High Pressures. Part XIII. By D. M. NEWITT. Communicated by W. A. Bone, F.R.S.

The experimental data from explosions of various $2CO+O_2+4CO$, $2H_2+O_2+xN_2$ and $2H_2+O_2+xN_2$ mixtures at high initial pressures have been analysed, and from the results the distribution of the heat of combustion at the moment of maximum pressure in such explosions has been ascertained.

On the Direct Determination of the Electrostatic Moments of Molecules. By R. J. CLARK. Communicated by Sir Ernest Rutherford, P.R.S.

A method is described for the determination of electric moments of molecules by direct deflection in a rapidly varying field. Preliminary experiments indicate that sodium and potassium atoms have either no permanent electric moment, or one that is

too small to measure. So far no polarisation by the field on these molecules has been found.

On the Criterion for Stability of a Layer of Viscous Fluid Heated from Below. By A. R. Low. Communicated by L. N. G. Filon, F.R.S.

Benard's experiments on the modes of instability of a viscous fluid heated from below attracted the attention of Rayleigh, who gave a mathematical account of the phenomenon with the special assumption of zero tangential forces at the boundaries, and found unexpectedly that the top-heavy layer of fluid was stable until a certain temperature gradient, negative upwards, was exceeded. He also discussed the modes of instability which appear when the critical value is slightly exceeded.

The Absorption Coefficient for Slow Electrons in Mercury Vapour. By R. B. Brode. Communicated by F. A. Lindemann, F.R.S.

A Mechanism of Gelatinisation. By F. L. Usher. Communicated by R. Whytlaw-Gray, F.R.S.

The Determination of Molecular Forces from the Viscosity of a Gas. By H. R. Hasse and W. R. Cook. Communicated by S. Chapman, F.R.S.

The Spark Spectrum of Thallium (Tl III). By J. C. McLennan, F.R.S., A. B. McLay and M. F. Crawford.

Tests of Significance in Harmonic Analysis. By R. A. Fisher, F.R.S.

Sulphide Colours on Metallic Copper. By F. H. Constable. Communicated by T. M. Lowry, F.R.S.

The sequence of colours produced when a mixture of hydrogen sulphide and air or oxygen acts on metallic copper, has been shown by spectrophotometric methods to be a series of true interference colours.

The characteristic silvery colour is due to the flatness of the reflection maximum in the intensity wavelength curve.

The rate of formation of the colour sequence is much slowed down by the presence of a protective oxide film on the metallic surface formed by exposure of the reduced surface to air at room temperature, confirming Vernon and Evans conclusions.

The temperature coefficient of the reaction is unity from 0° to 180° C., but increases as the temperature rises above 200° C.

Waves and Tides in the Atmosphere. By G. I. Taylor, F.R.S.

The Ultra-Violet Spectrum of Magnesium Hydride II. By R. W. B. Pearse. Communicated by A. Fowler, F.R.S.

The bands of the many-lined ultra-violet (γ) system of magnesium hydride have been measured in the region λ 2560 to λ8240. The vibrational analysis shows that this system has no level in common with the previously known α- and β-systems. The rotational structure is that characteristic of the $'S \longrightarrow 'S$ type of electron transition.

The Second-Order Wave Equations of the Spinning Electron. By G. Temple. Communicated by S. Chapman, F.R.S.

THE PHYSICAL SOCIETY.

Friday, June 28.

A Demonstration of some Contact Devices used in an Apparatus for the Measurement of Electrical Resistance at High Temperatures was given by J. L. Haughton, D.Sc., of the National Physical Laboratory.

The following papers were read :—

The Relation Between Hydrogen Pressure and Filament Resistance in a Tube Containing Glowing Tungsten. By Teresa J. Dillon, B.Sc., Ph.D.

When a tungsten filament in a tube containing hydrogen is caused to glow, the gas rapidly disappears while the resistance of the filament rises progressively. The latter phenomenon can be used to measure the pressure of the hydrogen. It is suggested that chemical action takes place between the hydrogen and tungsten.

The Band Systems of Titanium Oxide. By Frances Lowater, Ph.D., F.R.A.S.

The bands of TiO have been found to extend toward the infra-red through some 800 A further than the range previously known.

The Absolute Measurement of Sound Intensity. By F. D. Smith, M.Sc.

An absolute measurement of sound pressure is described in which the sound is received with a moving coil receiver. The signal heard after suitable amplification is compared with the signal produced by a small known electromotive force *e* applied to the receiver. Since the measurement is independent of the amplifying circuit, it is possible to use a high degree of amplification and very feeble sounds may therefore be measured.

THE GEOLOGICAL SOCIETY.

Communications read :—

The Geology of the District Around Abbey-Cwmhir (Radnorshire). By R. O. Roberts, M.Sc. Communicated by Prof. W. J. Pugh, O.B.E., D.Sc., B.A., F.G.S.

The Geology of the Country Around Bodfean (South-Western Carnarvonshire). By

C. A. Matley, D.Sc., F.G.S., and Albert Heard, Ph.D., M.Sc., F.G.S.

The Petrography of the Borrowdale Series of the Kentmere District. By George Hoole Mitchell, M.Sc., Ph.D., F.G.S.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Medal for "Agricultural Research."

The Council desire to call attention to the offer by the Society of a Medal for Original Agricultural Research, the Regulations governing which are as follows :—

1. The Medal shall be called the Royal Agricultural Society of England's Research Medal. The Medal will be of silver, and money or books to the value of Ten Pounds will be added.

2. The Medal shall be awarded for a monograph or essay giving evidence of original research on the part of the candidate on any agricultural subject, on any of the cognate agricultural sciences or on agricultural economics. It must be signed by the candidate as the genuine work of the candidate himselm.

3. Candidates for the Medal must reside in Great Britain or Ireland, and must not be more than thirty years of age on 29 September, 1929.

4. The Medal shall be adjudged by referees appointed by the Council of the Royal Agricultural Society.

5. The Monograph or Essay shall be forwarded to the Secretary of the Royal Agricultural Society *on or before October* 31, 1929. The monograph or Essay shall be typewritten or printed.

6. If, in the opinion of the referees, no monograph or essay be found to attain a sufficient standard of excellence, they shall be at liberty to reserve the Medal of that year for award as an additional Medal in some subsequent year.

7. The monograph or essay of the successful candidate shall be published in the *Journal* of the Royal Agricultural Society, if, in the opinion of the Council, it is suitable for that purpose. Essays already published shall not be eligible for the Medal.

NOTICES OF BOOKS.

Annual Reports on the Progress of Applied Chemistry. 1928. Vol. xiii. Pp. 760. Issued by the Society of Chemical Industry. Price 12s. 6d.

British Chemists are fortunate in that the Chemical Society issues an *Annual Report* upon the progress year by year in the various branches of pure chemistry whilst the Society of Chemical Industry furnishes its account of the developments in the application of these discoveries and advances in the field of manufactures. Both works contain good summaries of each particular subject, compiled by the leading specialists, so that these *Annual Reports* constitute an invaluable record and guide for the non-specialist and also enable all interested in science to become acquainted with what is being done in the various branches of chemical science.

The volume under review contains the following contributions :—

General Plant and Machinery, by A. J. V. Underwood.

Fuel, by H. J. Hodsman.

Gas, Carbonisation, Tar and Tar Products, by H. Hollings.

Mineral Oils, by A. E. Dunstan.

Colouring Matters and Dyes, by Cecil Hollins.

Fibres, Textiles, Cellulose and Paper, by J. C. Withers.

Bleaching, Dyeing, Printing and Finishing, by L. G. Lawrie.

Acids, Alkalis, Salts, by C. J. P. Bateson, H. M. Broadhurst, A. Lamble and A. Williams.

Glass, by H. W. Howes.

Refractories, Ceramics and Cements, by W. J. Rees.

Iron and Steel, by W. H. Hatfield.

Non-ferrous metals, by A. R. Powell.

Electro-Chemical and Electro-Metallurgical Industries, by H. T. S. Britton.

Oils, Fats and Waxes, by T. P. Hilditch.

Paints, Pigments, Varnishes and Resins, by Members of the Oil and Colour Chemists' Association.

India-Rubber, by D. F. Twiss.

Leather and Glue, by F. C. Thompson.

Soils and Fertilisers, by E. M. Crowther.

Sugars, Starches and Gums, by L. Eynon and J. H. Lane.

The Fermentation Industries, by H. L. Hind and F. E. Day.

Foods, by F. S. Aumonier and J. King.

Sanitation and Water Purification, by J. Haworth.

Fine Chemicals, Medicinal Substances and Essential Oils, by W. H. Linnell.

Photographic Materials, by E. P. Wightman; and

Explosives, by J. Weir.

It will be seen how deeply chemical industry and, for that matter, pure chemistry ramifies into everyday life. There is scarcely an industry that is not deeply connected with chemical progress. During 1928

chemical industry progressed in all the important countries throughout the world. There was everywhere increased production, larger scope of operation and enlarged profits. Whether there was any improvement in the lot of the chemical research and process workers we are not, unfortunately, told. The first annual meeting of Imperial Chemical Industries was held in 1928 and the report showed that profits exceeded those forecast at the time of the amalgamation. This organisation now controls 40 manufacturing and selling concerns and has interests in nearly as many others. The tale of the I.G. Farbenindustrie in Germany is similar.

The *Annual Reports* of the Society of Chemical Industry on the Progress of Applied Chemistry undoubtedly contain a very useful summary of work published last year but the volume cannot claim to be absolutely complete. Thus, one or two papers of outstanding importance appeared in the *Chemical News*, but they have escaped the contributors' attention.

J. G. F. DRUCE.

The Economic Situation in Czechoslovakia. Report by H. KERSHAW, O.B.E., Commercial Secretary to His Majesty's Legation, Prague. Published for the Department of Overseas Trade by H.M. Stationery Office. 1929. Price 1s. 6d. net.

Czechoslovakia industry is fortunate, as trade flourished and the financial situation improved throughout 1928, as it has done continuously in the last few years.

Exports amounted to 21,228 million kc., as against 20,135 million kc. in 1927, and imports to 19,194 million kc., against 17,962 million kc., leaving a favourable balance of 2,034 million kc., as compared with one of 2,173 million kc. in 1927. In view of the efforts of all countries to supply their own needs and the existence of formidable Customs barriers, the success of Czechoslovakia in exporting over £130,000,000 worth of goods is a creditable achievement. Industrial output, relative tranquillity in labour circles, little unemployment, the productive use of capital, public economy, and heavy taxation yields, afford convincing evidence of national prosperity.

Industry on the whole is very good and the following branches may be characterised as flourishing :— Agricultural machinery, miscellaneous iron and steel, steel rails, electrical and other machinery, woollen, carpets, boots and shoes, porcelain, glass and glassware, leather and leather goods. Each of the foregoing showed increased exports as compared with 1927, and generally speaking there are few signs of any serious decline in orders. The iron and steel industry was very fully employed, largely owing to intensive building activity. Especially prosperous are the porcelain, glassware and boot and shoe industries. The pig iron, hosiery, coal and cotton yarn and piecegoods branches may be described as relatively good.

British trade with Czechoslovakia steadily increases with the growing national prosperity. With a greater purchasing power on the part of the public, the demand for good quality British goods will increase. Throughout the year negotiations took place with a view to the creation abroad of factories largely under Czechoslovak technical management and with the contribution of Czechoslovak capital. The industries chiefly affected were glass, sugar, textiles, metallurgical, boots and shoes, etc.

There is a considerable body of opinion in Czschoslovakia in favour of an improvement in the trading relations with Russia, especially as many of the Czechoslovak industries, particularly engineering, are, owing to the geographical situation, in a favourable position to supply much material of which Russia is in urgent need. Public opinion is not yet ripe for the conclusion of a definite pact, nevertheless, meetings between Czechoslovak and Soviet representatives intermittently take place with this end in view, and at the same time a moderate amount of trade is being carried on between the two countries, especially in the form of exports (mainly electro-technical goods, metals and engineering, agricultural machinery and sugar) from Czechoslovakia to Russia which, in 1928, were 90 million kc. greater than the imports from that country into Czechoslovakia. (Imports 189,216,000 kc.; exports 279,278,000 kc.)

The items of export of chief interest to chemists are glassware, porcelain, heavy and fine chemicals, cellulose products and sugar. All except the last item have shown a steady increase in quantity produced and exported although the value has generally fallen slightly.

The sugar industry has passed through a critical year for the world over-production and increased tariff rates have seriously restricted the export of Czechoslovak sugar both raw and refined.

Among the mineral ores (Czechoslovakia possesses almost all the useful metals) it is interesting to note that about 4 grams of

radium are produced annually and 7.8 grams are now in stock, apart from the quantities loaned out to hospitals at home and abroad; 1.8 gr. were sold last year.

Mr. Kershaw includes a commercial summary and a concise description of Czecho-slovakia and has written a brief note on Carpathian Ruthenia, the least developed area where, however, acetone, alcohol, sulphuric and hydrochloric acids are made and where salt, oil, and china clay are mined.

J. G. F. DRUCE.

Polar Molecules. By P. DEBYE, Ph.D., Professor of Physics and Director of the Physical Institute in the University of Leipzig, Germany. Pp. 172. Price $3.50. Book Dept., Chemical Catalog Company, 419, Fourth Avenue, at 20th St., New York, U.S.A.

This book deals in a succinct manner "with the conception of Polar Molecules as being systems having a distribution of electrical charges which can be characterised by a permanent electric moment." During recent years many contributions have been made to the literature of the subject, both from the experimental and theoretical viewpoint. The contributions have mostly appeared in scientific periodicals in various languages. So that a book of this kind was called for, as it gives in a compact form the results of the efforts of writers in various countries. The author states that he received helpful encouragement from a number of American scientists, which was all the more opportune, seeing that the author was writing in a language which was foreign to him.

Einfuhrung in die Theoretische Wirtschaftschemie. Von DR. R. KOETSCHAU. Pp. xii + 155. Dresden and Leipzig: Theodor Steinkopff. 1929. Price 12 marks.

Dr. Koetschau's excursions into the little trodden field of the science of chemical industry should find a wide public among industrialists as well as among technologists interested in the scientific advancement of their industry. Industrial Chemistry is as much a science as any other branch of the subject. It links up almost all the ather branches of pure and applied chemistry and Dr. Koetschau is at pains to trace the connections and the development of his "science." He treats it specially from the angle of physical chemistry and has not hesitated to reduce his deductions to mathematical formulæ and equations.

He has collected a useful and lengthy bibliography of the articles (almost all of which are in German) which have dealt with the subject matter treated in this book.

MAJOR F. A. FREETH.

Major F. A. Freeth, O.B.E., D.Sc., F.R.S., late manager of the Research Department of Messrs. Brunner, Mond & Co., Ltd., Winnington, and Mr. Wm. Rintoul, O.B.E., F.I.C., Manager of the Research Department of Messrs. Nobel's Explosives Co., Ltd., Ardeer, have been appointed Joint Research Managers to Imperial Chemical Industries, Ltd., Millbank, London, S.W.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

18,428.—American Potash & Chemical Corporation.—Calcined borax, and production of same. June 14.

18,484.—Anglo-Chilean Consolidated Nitrate Corporation.—Manufacture of sodium nitrate. June 14.

18,511.—Chemieverfahren Ges. — Production of alkali sulphates. June 15.

17,778.—Guillissen, J., and Union Chimique Belge Soc. Anon.—Manufacture of fluosilicate of sodium. June 10.

18,217.—Hofer, P., and Kali-Forschungs-Anstalt Ges.—Production of potassium nitrate. June 18.

Specifications Published.

284,588.—I. G. Farbenindustrie Akt.-Ges. —Process for obtaining anhydrous acetic acid from its aqueous solutions.

285,017.—Selden Co.—Process of purifying phthalic anhydride.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

310,529.—Synthetic Drugs. — Vereinigte Chemische Werke Akt.-Ges., 16, Salzufer, Charlottenburg, Berlin.

6-Alkoxy-5 : 8-diaminoquinolines are prepared by dinitrating the oxyquinoline, reducing the product and alkylating the di-

amino compound so obtained; or the oxyquinoline is mono-nitrated, alkylated, and *the alkoxy-mononitro compound further* nitrated and reduced. In examples (1) 6-methoxy-8-nitroquinoline is nitrated and the dinitro compound so obtained reduced; (2) 6-oxy-5.8-diaminoquinoline is treated with dimethylsulphate. 6-Methoxy-8-nitroquinoline may be prepared by converting 1-amino-2-nitro-4-oxybenzene to 6-oxy-8-nitroquinoline by Skraup's synthesis, and alkylating. By nitrating this oxy-mononitro compound and reduction, the 6-oxy-5.8-diamino compound is obtained.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ALBUGEN.

496,588.—Chemical substances in class 1 for use in manufactures. — Leicht-Metallverwertungs-Gesellschaft mit Beschrankter Haftung, 42, Dietrichstrasse, Trier, Germany, June 19.

PERFLOORS.

499,264.—Preservative dressings for concrete surfaces, being chemical substances in class 1.—Plastona Ltd., Graham Works, Graham Road, Wimbledon, London, S.W.19. June 19.

AUDEX.

502,857.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—Samuel Wills & Co., Ltd., Castle Green Colour Works, Castle Green, Bristol. June 19.

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GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

MATTER AND LOGIC.

By DR. W. TOMBROCK.

In 1928 *The Chemical News* issued a series of essays which may be catalogued this way: *Matter and Logic—An attempt at a Logical Explanation of Material Properties and Natural Phenomena.* (Vol. CXXXVI, pp. 193, 289, 337; Vol. CXXXVII, pp. 1, 66, 113, 149, 198.) Because of some criticisms which I have since received upon these ideas I intend summarising the fundamental thoughts set forth therein and again elucidating their principal aims.

But firstly we may answer this criticism which presented two aspects. The first of these aspects can be summed up in this form: "Must a scientific system be necessarily logical?" In this connection the opponent usually points to the divergence of the phenomena taken into consideration and to the narrowness of our own perceptive power. The second sort of criticism took a more concrete form: You seem to attribute to the ether gaseous properties—do you know of the very great difficulties the physicists have experienced in considering ether as a gas-mass?

As for the first objection regarding the logical integrity of a scientific system, we may reply briefly. One may term "logical" any system which is based on sound, irrefutable premises and which does not contain erroneous deductions, whereas illogical systems, those which lead to contradictions, must necessarily contain a mistake here or there, *viz.*, in their premises (assumptions) or in their deductions. Consequently, each scientific system ought to be faultless—"logical"—at least we are bound to make endeavours to obtain it so. Incidentally, it may be observed that the putting of definitions, the circumscription of ideas and concepts we make use of, is very important. *We are bound to put forth our definitions as sharply as possible because ideas and concepts which are swimming round in vague and loose circumscriptions are apt to lead to incongruities, even to contradictions.* Again . . . it must be considered a sacred duty to the scientist to set forth his definitions clearly and once having set them forth to observe and maintain them rigorously.

Whoever has once clearly and sharply distinguished between matter, energy, and force, for example, will not at the end of ever so much reflection be forced to ask himself: cannot matter be energy or matter be force?. . . this question having thus been implicitly accounted for beforehand.

less, its rotational velocity, however, greater? And is it not in this proceeding if in anything that we have to seek the cause of gravitation? Indeed the effect of the transit of ether particles through the proton-mills would have to be that the ether pressure in their immediate neighbourhood would become smaller. *Should* the proton-mill completely nullify the translatory motion of the ether particles passing through then the proper repulsive force of these particles would thereby disappear, consequently the ether pressure would diminish; the effect would be as if the ether had become rarer. The latter would make it understandable that this *apparent* rarification of the ether would make itself most felt in *between* various atoms, molecules and aggregates of molecules, and the result would be that these are pressed together by the rest of the ether particles which, while not passing through the atoms, can exert a pressure on them. It would be as if the proton-mill tried to suck the ether around it, and it is to be considered that the (apparent) force of attraction (gravitation, cohesion, etc.) caused by this must be proportional to the number of protons and proton-complexes (atoms).

Anyhow, it seems obvious that this simple and least hypothetical conception of matter, consisting out of strongly rotating protons and of ether particles moving somewhat like gas molecules gives us at first hand a quite easy and understandable explanation of those most conspicuous and fundamental natural phenomena: *light and gravitation*.

But now: what about the atom of Bohr?

Risking the article to become now too schematical and even more or less incorrect bere, I will try to answer your remark and to see the conception of Bohr in the light of our understanding of matter.

It was Planck who, while experimenting with light phenomena, found a constant which induced the physicists to give their attention once more to the emissory character of light, long though it had been neglected for the prevailing theory of undulation. Let us assume this constant to correspond to a real factor in our conception of matter as, for example, the average size of the ether particles. Then it was Bohr who gave a relation between this factor and certain numerical properties of the atomic spectrums. This relation Bohr interpreted somewhat in this manner: in a given atom there are so many—and no more—orbits for an electron to circulate in.. Against this interpretation which curiously enough gives an impression of dogmatical reminiscence, against this interpretation of Bohr more than one scientist has made objection, let alone here the other yet more difficultly conceivable demands this conception forces upon our imaginative faculties. But the fact remains that Bohr has succeeded in obtaining a relation between certain irrefutable experimental results and other equally irrefutable numerical spectroscopic properties. This relation then may be of mere mathematical value, it may be more or less symbolic as we understand it, but this relation does exist, a very brilliant mathematical interpretation. And though we do as yet not see it clearly, it is possible, not to say very probable that it gives us a schematical, a brief and incomplete picture of underlying reality. It may even stand as a symbolical, schematical, brief and incomplete representation of the atom as it was here above given before. Do not ether-particles here circulate somewhat like the electrons? Is it not easily conceivable that in our cyclonic movement periodic, intermittant changes should occur near akin to the jumping of an electron from one orbit to another, and giving the atomic configuration a somewhat pulsating character? Is it not possible that our cyclonically stable atomic configuration or proton mill, as we call it, should bear to its spectrum the same relation, as that which a humming-top bears to its characteristic tones? . . . But let us recur to a more essential part of our treatise.

"Is nature contradictory?" is the superscription of one of our essays (Vol. CXXXVII, p. 138) in which several contradictions occurring in modern physics were quoted. We will not repeat them here so as not to become too tautological. But nevertheless they *do exist* and now we ask: How is it possible that they can occur in physics, in the so-called exact science itself?

What is matter? What is energy? What is force? Does there exist a difference between the first, second or third dimension and the fourth (and more) dimension(s)? Yes or no? If yes, then what consequences are to be deduced from this distinction? So long as physicists do not exert themselves to give answers to these questions, so long as they do not put clear and sharp definitions to their fundamental concepts, so long as they do *not* rigorously observe and maintain these definitions, so long do they give freedom to all kinds of incongruities and even contradictions to enter their dominion of science. And don't forget that the most conspicuous criticism made upon these

essays : "Ought a scientific system to be logical?" is a salient confirmation of their soundness.

Finally, to avoid any possible charge of being ourselves vague and loose in our reasoning, we will repeat here the definitions assumed by us for this and for our previous essays :

Matter is that which moves, is the substratum of *all* physics, is substantial.

Energy is a type of motion, is a condition, a quality briefly : a property of matter. Energy is not substantial but additional.

Force, a fictitious imaginative means to calculate effects of motion. This as far as concerns purely physical (chemical) force.

Three-dimensionality does indeed correspond completely to reality and, for matter, is to be regarded as essential, characteristic and fundamental.

June, 1929.

Bergen op Zoom (Holland).

THE MAGIC MEDICINE OF THE HOTTENTOTS.

By P. W. Laidler, L.R.C.S & P., D.P.H., F.S.A. (Scot.),

Medical Officer of Health, East London.

(Abstracted from the *South African Journal of Science.*)

(*Continued from page 5.*)

Medicines.

Kraalbosch, D/kooi-dabee, Kraal bosch, *Galenia africana*, is chewed for toochache, in small quantities. If too much is used it *blisters the mucous membrane of the mouth.* This bush is now used in a mixture in decoction with Aister bosch for toothache and also for venereal disease.

Sages. Aromatic sage, Afrikaanse Salie, Blaauwblom, *Salvia africana* and *Salvia aurea*. Decoction of leaves used for coughs and colds and also for women's troubles. Wittle blom. *Nuxia congesta*. Salie prout. Leaves resemble those of a sage. *Buddleia salvifolia*. *Tarchonanthus camphoratus.*

Stink sali (small grey whitish leaves), dried leaves used in decoction for common colds and externally as a lotion for sores. Berg salie, or mountain sage, green or dried leaves in decoction for coughs and colds, is evidently an expectorant, as it is stated it makes the cough ripe. Also used in decoction for washing sores. To-day these salies are used in combination with Katakruie and plein hout and vaal bosch for fevers, such as measles.

Wild olives are used to make diaphoretic mixtures, or sweating draughts. One species, named in Nama, P/koem, is used in decoction of leaves for dropsy, flatulence, and pains in the stomach, as a lotion for sores, and also the leaves are used as a plaster. The most prized is the sand olein houd, the Nama D/koubi, a decoction of the leaves of which is administered in any cold or fever, from a common cold to typhoid.

Klein koorts bosch, little fever bush, *Grassula lycopodioides* L., is used in decoction as a diaphoretic.

Taaibosch, L/ or P/guara, *Rhus* sp. or *Rhus undulata* Jacq. The leaves of this plant are boiled and the liquor given for the troubles which arise after parturition. Of the two species of bush, long and short, the latter is preferred.

Vogelent, *Viscum capense* Lin. Nama Aie L/kwoe, a Taaibosch parasite, is used as an emmenagogue. Barend uses it for amenorrhea, mixed with P/au, wild celery. By the Cape Boers it is used for epilepsy, chorea, and diarrhoea.

L/aiser, a bush not identified, is used in decoction for puerperal fever. It is strongly purgative, and as the Native doctor says : "works the fire out of the stomach." It is never used for the young, but only for adult women. One informant states particularly it is used, when the patient is delirious, to "work it out."

Faierrank, Nautsi amma (Nama), a red tipped faier rank, *Memembrianthemum edule* or *acinaciforme*, is used for delayed labour, or retained after-birth. It is stamped and given as a pulp.

Haakiesdoorn, P/ahbi, is also an emmenagogue.

P/ngoona, a thorn bush, *Sarcocaulon sp.*, pounded whole and boiled, is a successful abortifacient according to many. Barend says that it is exceedingly good, but that he uses it only for parturient troubles in sheep. Klip melkbosch, *Euphorbia restituta*, given for tedious labours. When the treatment is continued for two or three days it "helps and strengthens."

Roode rabassam. Pappe, in his "*Flora Capensis*," mentions two Pelargoniums that are used medicinally in the Cape and Namaqualand, *Pelargonium antidysentericum*, in Nama D/kanie, which is boiled in milk and used as an astringent, and *P. anceps*, known to the Coloured and Afrikanders as *Roode rabassam* and used by the Cape Malays to produce abortion or for helping on a confinement. In Namaqualand this is known as rabass, which appears to be the original Nama name for it, or a corruption. The Afrikander names it rooi wortle or roii storm. It is used nor anaemias and weaknesses and repeated doses are given during fevers. The Boer uses it boiled or

"set op brandywijn." Baviaan's oor, Baboon's ear, Bol (Nama), *Eriospermum latifolium*, a red tuber, rasped up raw, used as a cold poultice on bruises and cuts, is considered good. The colour in each case appears to have been the chief attraction.

Kalkoen blom, or turkey flower, *Sutherlandia fructescens*, was used in decoction for washing wounds and given as drink for fevers. To-day it is used for consumption, chicken pox, etc. Rooi rainkie leaves, red again, are used as a poultice when thorns have pierced the foot, a common occurrence in a country covered with *Acacia horrida*.

Stinkbosch, *Nymania capensis* was, and is, given for convulsions. Stink bosch, Ou meide's bosch, or Old Woman's bush, P/kabou, *Boscia foetida*, is possibly used as an emmenagogue, but mainly, in so far as I can gather, as a decoction for pains in the back. There are a large number of aromatic bushes in the African veld, and many of these, in fact most, are in use, or have at some time past been used medicinally.

Rosemary, Nama name not identified, *Eriocephalus umbellatatus*, is used in decoction for pain in the stomach.

Stinkkruit is used in decoction for stomach pains, in cases of scorpion sting, pounded, moistened and applied cold as a plaster.

D/khammae or P/tkamma, "something that grows near water," aromatic thyme, used as a tea, as a diaphoretic.

The common fire bush, L/naroo, so named because of its domestic use, combines the characteristics of aroma with redness of its small thick, juicy, finger-like leaves, which are chewed for pain in the stomach.

Kattendoorn, or cat thorn, D/nuance, and the use of its roots in decoction in wasting diseases, has already been mentioned. It is probably a modern application of the ancient principles of sympathetic medicine.

Quickgrass, P/arre, which has jointed roots of tremendous length, is used in decoction for coughs.

Baboon rope, P/nyra sooriep, a species of liana, is burned and the ash sprinkled on ringworms. Several of the modern herbalists use it in decoction for boils, administered internally, as also they use the smaller climber, bakker bosch, *Synanchum capense*, Thun. *Passerina filiformis*, P/tou, which when lighted disapears in a blaze of flame, whence its usefulness to the baker after whom it is named, is used in decoction for shooting pains.

Suitduizel, *Berkheyra* sp., a holly-like little bush about three feet high that grows near rivers and springs, is used in decoction for the same ailment. Sam uses it in powder as a plaster for burns and boils.

Candle bush, *Sarcocaula Burmanse*, a smaller variety *Patersonii*, is gathered, pounded fine, and used as an astringent for diarrhoea. Because of its laborious method of preparation it is named D/nou D/nou, which Sam translates as "work-work," but which is evidently an onomatopoetic word representing the sound of the stamping. The root is ground fine and used as a poultice, which is peppery and acts like a mustard plaster.

Gums and resins are used to only a small extent.

Heyra, the exudation of the acacia tree, is used as a food, and when boiled with fat as a salve for whitlows and boils. Possibly the ease with which the tree exudes this substance was the starting point of this use.

Scaap rapayce, D/ta dou, a resin greener than the others, is eaten by animals, but not used much by man.

D/Goonu, the resin of several species of Euryops, is gathered in the sands of Bushmanland, where, having dropped from the stems of the bushes, it forms black concretions beneath; this is the reason that it is thought most of. It is boiled and the bitter decoction used in fevers. The red resin obtained from the woody parts of the same bush is also used. The stems of this plant when old are reddish and inflammable, even in wet weather.

Purgatives.

Purgatives are in great request. P/gameroo, a whitish tuber with flat, green leaves not unlike those of the pumpkin, is cut and boiled, and the liquor is used as emetic and purgative, in stomach complaints.

Kraaibosch, D/nareeree; *Royena hirsuta* L.; wild gentian known as the Ambiaer bosch, or piles bush, *Chiroma baccifeca*, of the decoction of which two mouthfuls is an efficient dose, have a rapid effect. It is also used in decoction for boils.

Snuffs.

As well as snuffs to drive out the infection of death there were snuffs that cured headaches.

White Kafir-wood. A bush with a red flower, unidentified, which grows around the Orange River, powdered fine, is snuffed for flatulence, and is a very pungent snuff. Also used in decoctions for the same purpose —slightly bitter.

Witte vergeit, a white chicory-like root, is powdered and used by some as a plaster, by others as a snuff. Barend declares that this is " first class " for headaches. Here, again, the principle is that of "driving out" by means of an explosive sneeze.

POULTICES.

Plasters and poultices are of common use to-day, and it appears that a soft hot application, whether cow-dung, the inside of a goat disembowelled alive to prevent loss of heat, or a preparation of herbs, was a favourite remedy with the Hottentots. The bulb of the C/koos P/naboo, veldschoon blaar or field shoes leaf, a large soft sole-like leaf is warmed, smeared with fat and applied to any swelling. P/nums ghana has been mentioned. D/nou D/nou was also used as a plaster, and this particular preparation is peppery, and has the same action as a mustard plaster.

The large number of bushes contained in the Hottentot Pharmacopoeia is the reason of certain seemingly filthy remedies being used. The modern goat-dung poultice is an animal preparation of immemorial repute, a preparation, too, warm and ready to hand of selected bush leaves. What then could be better to apply to a sore stomach? Such poultices have been applied by white people for pneumonia, appendicitis, peritonitis, and innumerable other complaints. For who knows more concerning the medicinal herbs of a country than its aboriginie? And whre could finer ground, ready to hand preparation be obtained than from the stomach of a goat or sheep? The stomach of the porcupine is dried and portions infused as required. Its action is diaphoretic. One man said that as long as he had that medicine he would never need any white or black doctor's help. Again the argument is that the porcupine eats so many " Bush things and strong things " that his stomach contents must be very good medicine.

ANIMAL PRODUCTS.

L/am uru. The most famous animal product, one that figures even in the price lists of the modern wholesale chemists, is dassiepis, L/am uru, or D/gaous, the inspissated urine and faeces of the rock rabbit, gathered from the clefts and crannies inhabited by them. Boiled and strained the liquor is given in dry confinements, during parturition generally, and for irregularities of menstruation. In large doses it is believed to be the perfect abortifacient. Deposits of Dassiepis acted upon by the atmosphere, which gradually removes all the organic matter, form a dark pitch-like mass, the dassiepis of commerce, which gradually changes into white potassium nitrate. The black intermediate product is called in Afrikaanse zwart bo meester, big black master, and the final product purified by air, bo meester, or grand big master, is potassium nitrate; it is the " big boss " of all medicines, dassiepis being given internally in decoction or infusion for all sorts of poisoning of whatever origin ,and it is rubbed into scarified snake bites and scorpion stings. It is also used in such minor complaints as stiffness of the back and pains in the stomach.

Klipsweet is boiled, strained and given as tea in insufficient flow of waters during parturition, and also for unhealthy menstruation. In large doses it is used as an abortifacient, in smaller doses for pains in the back. To-day it is considered an ideal medicine for children.

Nasal mucus is an old Hottentot remedy, a handy one and probably the first ever used, for burns. The cast snake skin is burned and the powder used for the same complaint. The ease with which the snake leaves its old skin and its similarity to the thin cuticle covering a blister are probably the reason of its use.

Hyena dung is precious, and in powder is given to children for convulsions. Among its modern uses is that of an insufflative powder in cases of diphtheria. So strong is the faith in this remedy, that no man, whatever be his colour, will see that white patch of faeces without pausing to pick it up.

Skins drawn warm off the living animal were used as an application for any severe pain. The use of such remedies has been world wide. It is mentioned by Miss Durham in " Man," 1918, 82, among the Balkan remedies, and the explanation for the use of warm sheep skin is similar to the Hottentot's explanation of his use of the porcupine's stomach—that the animal eats all sorts of herbs and that by this remedy the mixture thereof is enabled to soak into the patient.

C/ngama, a small greenish lizard about four inches long, is believed by the Native to be very poisonous. It is quick in movement and is called by the Nama, who kill it by thrown stones, the footed snake. The body is dried and powdered, and this is rubbed into scarifications over snake bites.

The Kanker beeste, or cancer beetle, is a small red and black flying insect which appears in decayed wood in spring. It is rubbed to pieces on warts—when the wart is

expected to rot or to fly away. The more modern-minded Barend uses Euphorbia milk for this purpose, but goes a step further with the beetle, for he applies it to cancers.

PRESCRIPTIONS.

An old and much praised remedy is oubae C/namop, which consists of burned and powdered ostrich egg shells mixed with tail fat of sheep or goat. This is rubbed into the chest of children affected with snuffles or coryza. In some cases it is applied over the whole body. The name of the ostrich shell is aboo P/nooroo.

Many bushes have interesting non-medical uses. Guaap, *Stapelia filifera*, a cucumber-like growth, is used as a thirst quencher; Vaarkies blaar is used after the eating of the flesh of animals that have died of anthrax, not as the Kafirs use certain shrubs to prevent the disease, but as an application to the boils that subsequently appear. Yet in 1928 several Bastards in Bushmanland died from the effects of eating anthrax-infected meat. L/kau Dhan, the fleisch-bosch or meat bush, has hard twigs with thick fleshy leaves, and is so named by the Dutch because the Hottentots used it as a support for meat after slaughtering to keep it off the sand, the reason for the choice of this particular bush being that, though in contact with the meat, it did not taint it. The P/abee, or fluities-bosch, the flute bush, was stripped of its bark to make a species of pipes of Pan, when no reeds were obtainable. It is never used now, and only the name survives to keep alive the memory of the Hottentot reed dances.

SALT AND GYPSUM IN ALBERTA.

The June issue of the Canadian Mining and Metallurgical Bulletin reprints the paper by Professor J. A. Allan, entitled "Salt and Gypsum in Alberta," prepared for the annual general meeting at Winnipeg of the Canadian Institute of Mining and Metallurgy. The Journal in question can be consulted at the Canadian Building, Trafalgar Square, London, S.W.1.

Professor Allan's paper was prepared to draw attention to the widespread distribution of salt-bearing and gypsum-bearing rocks, and to the stratigraphic importance of these rocks. The origin of the deposits of salt, gypsum, anhydrite and dolomite is discussed, and the economic significance of these minerals is considered.

PROFESSOR LEONARD HILL ON RIGHT AND WRONG HEAT RAYS.

Professor Leonard Hill put forward a plea for the greater use of smokeless appliances, in an address to a conference of Medical Officers of Health given at Newcastle-on-Tyne on June 21.

People like open fires because of the pleasant sensations produced by them. It has been shown that the horny layer of the skin is fairly transparent to the shortest wave-lengths of infra-red, and to visible rays, but opaque to the longer infra-red rays. These, in the case of the sun, are naturally absorbed by the water vapour of the atmosphere. Those rays which penetrate the horny layer of the skin and reach the nerves beneath it excite transpirations of water and so give a comfortable warmth; the longer infra-red rays, such as come off the ordinary dark sources of heat, on the other hand, produce a dry uncomfortable sensation of heat.

New gas fire radiants, he continued, have just been introduced which give a yellower light, richer in short infra-red and visible rays and, therefore, much more comfortable. New open fires have also been introduced for burning coke. Such developments as these, combined with gas and electric heaters and cookers, give us efficient smokeless forms of heating.

Dealing with the question of industrial smoke, Professor Hill said that in smoke-consuming furnaces, while black smoke was prevented, sulphur acids and much fire flue dust were discharged into the air. "We want to stop all this," said Professor Hill, "gas and electricity works should be combined for the common good. By such means we can make our cities into clean places, and with provision of gardens, parks and playing fields, people will come to enjoy better health and be much happier. The smoking factory chimney has been regarded as the sign of prosperity, but it would be much better to hear the buzz of machinery going in clean, sunlit shops. This would save the enormous sums now spent in hospitals on curing illnesses caused by a confined life in impure air."

Professor Hill stated that because of the corrosive effect of London's smoke-polluted atmosphere, the Houses of Parliament now required a million pounds or more of repair work, while it was estimated that the smoke curse in Manchester was responsible for an increase in the city's washing bill of £250,000 per year.

GENERAL NOTES.

SYNTHETIC NITROGEN AND NITRATE SODA.

It is officially announced that an agreement has been arrived at between the Chilean Finance Minister, Señor Pablo Ramirez, and Imperial Chemical Industries Limited, having for its purpose closer co-operation between Synthetic Nitrogen and Chilian Nitrate of Soda, on similar lines to the agreement concluded between the Chilian Finance Minister and the I.G. Farbenindustrie A.G., which agreement is being announced concurrently.

An agreement has also been concluded between Imperial Chemical Industries, Ltd., and the I.G. Farbenindustrie A.G., with regard to co-operation between those two Companies in the production, marketing and propaganda of Synthetic Nitrogen products.

The agreements provide for a common policy to be pursued in the future regarding propaganda and similar matters relating to Fertilisers. A substantial basis for the stabilisation of the Nitrogen Industry has thus been reached, and it should be noted that this stabilisation is accompanied by a substantial reduction in the prices of Nitrogenous Fertilisers amounting to 10s. per ton This is a matter of great importance to the agricultural industry of the world. Even before this latest reduction the price of nitrogenous fertilisers was substantially lower than it was before the war. The large nitrogen producing groups are therefore making a considerable effort to assist farmers in the present crisis through which the agricultural industry is passing.

The agreement between the three largest producers of nitrogenous fertilisers in the world, outside the United States, should pave the way for a stabilisation of the nitrogen industry, inasmuch as it is proposed to invite the other national groups of nitrogen producers to come into line.

PROPOSAL TO DEVELOP McMURRAY SALT DEPOSITS.

The Hon. J. E. Brownlee, Prime Minister of Alberta, has declined to accept an offer made by Sir Thomas Tait, and his associates of the Canadian Salt Company, to develop the recently discovered salt deposits of the McMurray area in Northern Alberta. The Premier bases his refusal on the grounds that the promised development was on too small a scale, and the concessions asked for too great.

Sir Thomas Tait made his offer subsequent to a visit to the McMurray field, undertaken with a view to making proposals to the Alberta Government for the establishment of a salt plant there and for the development of the salt industry. He proposed to immediately drill two wells and to instal and equip a plant with a capacity of 35 tons of salt per day, provided that results were satisfactory. Exclusive rights were sought to win salt within 25 miles of McMurray, subject to any rights now held by the Alberta Salt Company, also permanent waiving of all royalties on salt, complete tax exemption for 21 ears ;and free transfer of Crown lands sufficient for a plant.

In his reply to Sir Thomas Tait, Mr. Brownlee pointed out that although he understood that 35 tons a day represented only an initial stage in the proposed development, it was not indicated when this development might be extended by the Company and further that the concessions asked for were more liberal than had been extended to any industry so far established in the Province.

£600,000 U.S. CREDIT FOR RUHR CHEMICALS CORPORATION.

Big Industrial Deal Follows Accommodation for German Government.

A $3,000,000 (£600,000) six-year credit at 8 per cent. for the Ruhr Chemicals Corporation was arranged recently by Dillon Read & Co., of New York, in association with a German banking group consisting of the A. Schaaffhausenscher Bankverein, the Deutsch Bank, Messrs. Simon Hirschland and Messrs. A. Levy.

Following close on the $50,000,000 (£10,000,000) credit for the Reich arranged by the same U.S. interests, this credit brings the total of Dillon Read financing in Germany to well over $306,372,600 (£61,274,500). Of this total, German banks have received $40,000,000 (£8,000,000), electricity companies $70,000,000 (£14 millions), and the United Steel Works group $124,000,000 (£24,800,000). In addition to this participation in industrial development, Dillon Read recently headed the international consortium which arranged the credit of $50,000,000 (£10,000,000) for the German Government.

Ruhr Chemicals Corporation is one of the two outstanding examples of industrial rationalisation in the coal, iron and steel companies of the Ruhr district. The other is the Ruhr Gas Corporation, also financed by Dillon Read & Co. This concern is

spreading a network of gas pipe lines through Western Germany, utilising the surplus coke-oven gas of the Ruhr heavy industry.

The same raw material, coke-gas, formerly wasted, is the basis of the development of Ruhr Chemicals, which uses the gas for nitrogen products, chiefly fertilisers.

Germany now produces nearly half the world's supply of synthetic nitrogen. The Ruhr Chemicals Corporation has just put into operation a plant combining the Concordia-Linde process for turning coke-gas into nitrogen and hydrogen, and the Casale process for converting these into synthetic ammonia. The construction of the plant was financed by Dillon Read & Co. with a loan of $4,000,000 (£800,000). The new credit will extend the plant to more than double its present capacity. Next year its production is expected to reach an annual capacity of 500,000 netric tons of nitrogen products.

BRITISH INDUSTRY FAIR CHANGES.

The first application forms for space in the London Section of the British Industries Fair, which is to be held from February 17 to 28 next year in the specially reconstructed Olympia, Hammersmith, were issued by the Department of Overseas Trade on Saturday, June 22.

The move from the White City may be said to mark a new era in the history of the Fair. The London Section was previously housed at the docks, the Victoria and Albert Museum, the Agricultural Hall, Crystal Palace, and latterly at the White City.

"This will be the first time we have been able to hold the Fair in a building adapted for the particular needs of British Industries Fair exhibitors and buyers," an official of the Department of Overseas Trade said in an interview.

"The work at Olympia is being hurried on. A new four-storey building for the Fair is being put up. It cannot be finished until the Fair of 1931, but two floors will be complete by February next and by means of bridging the galleries of the existing buildings and other reconstruction work, there will be ready for the coming Fair a vast two-storey exhibition building, the first of its size and kind in the country.

"The chief advantages of the new site are that the buildings are designed for the purpose; they are compact in arrangement so as to bring all sections into close touch with one another; and there will be three main entrances so as to give easy access to every section. These are all improvements which will make the work of the trade buyers easier than in the past.

"Secondly, the buildings are intended for use at any time of the year. The heating and ventilation, consequently, will leave little to be desired and instead of the impossible task of improvising kitchens and restaurants for a fortnight each year, we shall have the service of a permanent catering organisation working with all the equipment and facilities of a first-class restaurant."

In view of the temporary contraction of space, application forms this year are being issued direct only to those manufacturers who exhibited in either 1927 ,1928 or 1929, thus giving them a slight start over other manufacturers who, if they wish to exhibit, are invited to apply to the Department of Overseas Trade for the necessary forms.

The trades exhibiting in the London section will be as before—that is to say the lighter trades—while the engineering and other heavy trades will again be confined to the Birmingham section at Castle Bromwich. The Empire Marketing Board is again arranging a comprehensive exhibit of the food products of the Home Country, the Dominions and Colonies as well as of raw materials from the Empire.

CANADA AND THE BRITISH PREFERENTIAL TARIFF.

Desirability of a Speedy Decision.

Mr. J. Moir Mackenzie, Joint Head of the Federation of British Industries Overseas Organisation, has just returned from a short visit to Eastern Canada, in the course of which he spent some time in Ottawa.

During his stay in the Dominion, Mr. Mackenzie was received with all courtesy and friendliness and was given the fullest opportunity of explaining as he did to the necessary authorities the anxiety of the Federation of British Industries and British manufacturers individually to work in to the very best of their ability with any regulations which the Government of Canada might see fit to introduce from time to time.

It will be remembered that on the 1 February of this year, Canada brought in a regulation stating that the percentage of British raw material and/or labour in any manufactured article must be 50 per cent. or over if that article were to secure the benefit of the British Preferential Tariff Rate in Canada. While the vast majority of goods manufactured in this country can readily be certified to as containing 50 per

cent. or more of British raw material and/or labour, there are certain manufactured goods which fall just short of this percentage. The Government of the Dominion of Canada has expressed its willingness to consider the whole facts of cases which the manufacturers of such goods may lay before it.

A Customs Investigation Officer has very recently arrived in London to go carefully into the facts of these cases. While he is naturally making his enquiries with all expedition, some time is bound to elapse before the results of those investigations can receive proper and adequate consideration in Ottawa and the decision of the Government of Canada be given upon them. It will be appreciated that whatever decision is finally come to, that decision lies entirely with the Government of Canada.

When discussing the question in its hroader aspect with the various Governmental authorities with whom he had convertations in Ottawa, Mr. Mackenzie urged that whatever decision or decisions might be arrived at finally, it would be of great and real benefit to the various British manufacturers concerned if some ruling of a definite nature could be arrived at at the earliest possible date. The reason advanced was that the longer the delay involved in arriving at a decision, the greater is the chance of various goods which are in an uncertain position being supplied to Dominion buyers and consumers by foreign competitors of British manufacturers, with the inevitable risk that once a trade has got into other hands, it may be very difficult indeed to recapture it as a later date.

AGRICULTURAL RESEARCH STATION.

The new Agricultural Research Station of Imperial Chemical Industries Limited at Jealott's Hill (Warfield, Berks.), was formally opened by The Rt. Hon. J. H. Thomas, M.P. (Lord Privy Seal) on Thursday, 28 June.

Among those present were The Rt. Hon. Lord Melchett, P.C., LL.D.; Mr. L. S. Amery, the Prime Minister of Egypt, Dr. Bosch, Dr. Bueb, Sir Harry McGowan, The Marquis of Reading, The Earl of Birkenhead, The Rt. Hon. Lord Weir, The Rt. Hon. Lord Colwyn, Sir Max Muspratt, Mr. J. Rogers, Mr. B. E. Todhunter, Mr. J. H. Wadsworth, Col. G. P. Pollitt, Mr. J. G. Nicholson, The Hon. Henry Mond, Mr. H. A. Mitchell, Sir A. D. Hill, Sir Frederick Keeble, Sir David Milne-Watson, and agricultural experts from all over Britain. Speeches mere delivered by Lord Melchett, Mr. J. H. Thomas, Sir David Milne-Watson, Sir Frederick Keeble, Sir Harry McGowan, Lord Reading, Mr. John Garton, Sir Daniel Hall and Lord Birkenhead.

The new research station is the finest of its kind in the world. It comprises two forms, Jealott's Hill and Nuptown. The acreage of the former is 360, of which 160 is under the plough; the latter consists of a grass holding of 76 acres. The estate is thirty miles from London on the south of the Thames, midway between Windsor and Wokingham.

The Jealott's Hill Station is the new research headquarters of Nitram Limited, the distributive and research organisation for the farm fertilisers side of Imperial Chemical Industries. It will be the centre of farm research, not only for the United Kingdom, but for the whole of the Empire. It will thus be both complementary to the manufacturing side of Imperial Chemical Industries activities, as represented by the great factory at Billingham-on-Tees, and also a centre of the vast organisation for farm research which extends throughout the Empire, and indeed, throughout the whole world. The new station will make a much greater degree of co-ordination in this valuable work possible.

The Research Station, of course, is equipped with magnificent laboratories for analytical work of all kinds, such as the examination of soil and fertilisers, and for research into such subjects as animal nutrition, biochemistry, botany, plant physiology, bacteriology, and general microbiology. The laboratories and office buildings comprise an optical and photographic dark room, a sterilising room, a machinery and preparation room, library and conference room, staff common room, kitchens, etc. At the laboratories there will be displayed both apparatus and equipment used for the investigation of soils, fertilisers, crops, some of the methods used in testing soils. There will also be a cinematograph display illustrating the Intensive System of Grassland Management.

After the opening ceremony, visitors were able to inspect any of the many research activities of the station. The experiments themselves were explained by special demonstrators. Of special interest were the Smallholding Dairy Trial, which is a trial on a 17-acre field, managed as if it were a separate unit detached from the rest of the estate. Here was shown how a small holder, by proper management and the judicious use of fertilisers, may carry a large herd of stock on a small area and make a living out

Proceedings and Notices of Societies

ROYAL INSTITUTION OF GREAT BRITAIN.

Paper read on Friday, March 22, 1929, Sir James Crichton-Browne, J.P., M.D., LL.D., F.R.S., Vice-President, in the chair: *Penetrating Radiations.* By Sir Ernest Rutherford, O.M., LL.D., Pres.R.S., M.R.I., Professor of Natural Philosophy, R.I., and Cavendish Professor of Experimental Physics, University of Cambridge.

In recent years there has been a rapid growth in our knowledge of new types of electromagnetic radiations of very short wave lengths which are able to penetrate great thicknesses of matter before they are absorbed. The discovery of X-rays, which correspond to light waves of very short length, opened up a new field of study, and this was further widened by the discovery that radium and other radioactive bodies emitted radiations of the same type, but of a far greater power of penetration. A still further extension of our ideas has come from the proof that there exists in our atmosphere a type of ultra-penetrating rays, often called the cosmic rays, of about 100 times the penetrating power of gamma rays. The frequency of vibration of these cosmic rays is from 100 to 1,000 million times greater than that of ordinary light.

The main factors which control the absorption of these radiations are now well understood. For ordinary X-rays the quantum of radiation in passing through the atoms of matter occasionally collides, or rather interacts, with one of the component electrons, and the whole wave-energy of the quantum is given to the electron, which is set in rapid motion and ionises the matter in its path. The chance of such a conversion of the energy of the radiation, called the photo-electric effect, increases rapidly with the weight of the atom, and falls off markedly as the frequency of the radiation is raised. It is for this reason that, weight for weight, heavy elements absorb X-rays much more easily that light elements.

Another process, called scattering, which leads to loss of energy from the radiation is also always present. The effect of this is small for ordinary X-rays, but becomes predominant for very high frequency rays, and indeed controls the absorption. In this scattering process, called the Compton effect, there is a peculiar type of interaction called the quantum and the electron which differs markedly from the photo-electric effect. The radiation is scattered, and at the same time the electron is set in motion. The scattered radiation is degraded in frequency in amount depending on the angle of scattering. In very penetrating rays the average frequency of the scattered wave is reduced to about one-half for each scattering collision, and about half the energy on the average is given to the recoil electron. Consequently when a very penetrating radiation passes through matter recoil electrons of high speed and degraded radiations are always present.

A number of experiments were shown to illustrate the laws of absorption of penetrating radiations of the X-ray and γ-ray types. A new method devised by Professor H. Geiger for detecting and counting the individual recoil electrons produced by the penetrating radiations in our atmosphere was shown in operation.

The experimental information is at present too scanty to fix with certainty the origin and nature of these extraordinarily penetrating rays. It has been suggested that they come from outer space, and represent radiations which arise in the destruction or creation of atoms. The energy of the quantum in the most penetrating radiation measured by Millikan is of the order of 1,000 million volts. It may prove significant that radiation of this energy may be expected to arise if the proton can be converted into radiation by a single catastrophic process. Some time ago Jeans suggested that the transformation of protons and electrons into the energy of radiation appeared to be necessary in order to account for the long lives of the hot stars.

ROYAL INSTITUTION.

A general meeting of the Members of the Royal Institution was held on July 1, Sir Robert Robertson, Treasurer and Vice-President, in the chair. Miss K. V. Cove, Mr. A. Gollin, Mr. W. H. Nottage, Dr. David Russell and Mrs. H. A. Waymouth were elected Members.

BRITISH DRUG HOUSES NEW LISTS.

We have just received the latest (July, 1929), Catalogue of B.D.H. (British Drug Houses) Fine Chemicals. A number of new organic derivatives are listed for the first time and so are cobalt iodide and Titanium Potassium Fluoride.

NOTICES OF BOOKS.

Experimental Researches and Reports. Published by the Department of Glass Technology, Sheffield University. Vol. XI. 1928. Pp. 206.

The results of investigations upon glass, carried out by Prof. Turner and his co-workers at the University of Sheffield, have been collected together in the *Experimental Researches and Reports* issued annually by the Department of Glass Technology and constitute a valuable record of the progress and trend in glass researches. In the latest volume there are 17 communications which have been reprinted from the *Journal of the Society of Glass Technology, Reports of the Progress of Applied Chemistry, The Journal of the Chemical Society*, and one or two other publications. Most of those delivered before the Society of Glass Technology have already been abstracted in *The Chemical News*. Mr. Cousen's article on *Glass* which was contributed to the *Annual Reports* of the Society of Chemical Industry gives an admirable survey of the year's activity in this field. It occupies 18 pages of the present volume and comprehensively deals with all aspects of the study of Glass and Glassware.

Papers reprinted from the *Journal* of the Chemical Society treat of purely chemical aspects of glass technology.

Forthcoming Events.

THE INSTITUTE OF METALS.

The forthcoming Congress of metallurgists to be held in Düsseldorf from September 9-12 promises to be extraordinarily interesting. Already nearly 200 persons from all over Europe — and some from America—have indicated their intention to participate in the gathering.

The congress will comprise (a) the presentation and discussion of abolt 15 scientific and practical papers relating to metallurgical work; (b) visits to works in or near Düsseldorf and Berlin; (c) Receptions, dances and other social functions.

Persons who desire to participate in the congress should write for particulars without delay to the Secretary of the Institute of Metals, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

18,611.—Badger & Sons, Co., E. B.—Manufacture of acetic anhydride. June 17.

19,182.—Blagden, J. W., Simco, S. E., Clark, G .C. H., and Howards & Sons, Ltd.—Separating higher alcohols from other substances. June 21.

19,004.—Federal Phosphorus Co., Inc.—Production of crystalline aluminous oxide abrasives. June 20.

19,005.—Federal Phosphorus Co., Inc.—Acid calcium phosphate. June 20.

19,006.—Federal Phosphorus Co., Inc., Production of di-ammonium phosphate. June 20.

Specifications Published.

313,466.—Horsley, G. F., and Imperial Chemical Industries, Ltd.—Production of aldol and crotonaldehyde.

313,541.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of complex metallic salts.

294,626.—I. G. Farbenindustrie Akt.-Ges.—Process for concentrating aqueous acetic acid.

form of localisation.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

287,093.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of organic arsenic preparations and the application thereof as seed grain immunising media.

313,651.—Dreyfus, H.—Manufacture of aliphatic acids.

Abstract Published.

310,949.—Titanic hydroxide.—Blumenfeld, J., 129, Avenus des Champs Elysees, Paris.

The hydrolysis, under heat, of titanium salt solutions is assisted by the addition of a small amount of a nucleus liquor containing nuclei of titanic hydroxide which are still capable of being dispersed wholly or par-

tially by dispersing agents into a condition of apparently *homogeneous solution*. The nucleus liquor may be obtained by hydrolysing a titanium salt of low acidity under heat with subsequent cooling to stabilise the nuclei produced. For instance, a portion of the main solution may be added to an alkali until the acid concentration of the liquor has a *p*H value of 2-7 or preferably 4-4.5 hydrolysis be effected at 70-80° C. for, say, 15-30 mins., and stabilisation be then obtained by rapid cooling to below 60° C.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

LEPTON.

501,355.—Coal tar dyestuffs.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. June 26.

498,702.—Illustration of a shell and the words SHELL BRAND. Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes, all being goods for sale within the United Kingdom of Great Britain and Northern Ireland, and for export to and sale in the Irish Free State only, but not including mustar, mustard oil and mustard preparations.—Shell-Mex, Limited, St. Helens Court, Great St. Helens' London, E.C.3. June 26th.

NATIVOPHOS.

499,232.—A pharmaceutical and dietetical preparation containing vitamins and salts of the inositehexaphosphoric acid.—Cristallo A.-G., Thusis, Switzerland. June 26.

FIRADOL BRAND.

502,903.—Chemical substances prepared for use in medicine and pharmacy.—H. R. Napp, Limited, 3 & 4, Clements Inn, Kingsway, London, W.C.2. June 26.

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GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

CHEMILUMINESCENCE.

By ERIC K. RIDEAL, M.B.E., D.Sc.

(Lecture delivered at the Royal Institution on February 15, Sir Robert Robertson, K.B.E., F.R.S., Secretary and Vice-President, in the Chair.)

In attempting to make the subject matter of this discourse as experimental as possible it will be impossible to delve in great detail into the molecular mechanism of the reactions. This, I think, is as well, because many of the reactions which should be shown on account of their great beauty, are certainly extremely complicated, and have not, in fact, been subjected to any but a very superficial examination.

Chemiluminescence may be regarded as the counterpart of photo-chemical processes. By the absorption of light of suitable frequencies atoms and molecules may be raised to states of higher initial energy. These excited entities may now undergo a series of changes, the nature of which will depend on a variety of circumstances. They may liberate their absorbed energy in the form of fluorescent light, impart part or all of their energy by a collision to a neighbour of another species, become converted into a metastable more permanent and energy rich molecule, which may subsequently revert back into the normal form, or suffer some species of chemical reaction such as ionisation, dissociation or combination.

By suitable modification of conditions one can affect the velocities of chemical reactions over relatively wide ranges, and it is found that in many strongly exothermic reactions there exists a narrow range of relatively high velocities which is chemiluminescent. Closer examination indicates that practically all these reactions are complex, in that they are accompanied not only by the emission of radiation localised in some portion of the spectrum, but also by a rise in temperature. It is by a study of the chemiluminescent portion of such composite reactions that we may hope to gain a further insight into the molecular mechanism and the operation of the process of chemical activation. We may with some degree of assurance assume that chemiluminescence is in many cases the result of liberation of chemical energy in a form similar to that of fluorescent energy, and we have noted that fluorescence is the result of decay of a number of excited molecules, the excitation being produced in this case by the absorption of radiation.

Thus conditions suitable for chemiluminescence result in reactions in which large numbers of excited molecules are produced by chemical reaction, under conditions such that at least a fraction of the excited molecules can revert to the normal form with the emission of radiation. Excluding thermally accelerated exothermic reactions, a large group of auto-accelerating reactions exhibit chemiluminescence; these are usually designated as branching chain reactions, and we shall observe that there are several hypotheses as to the nature of such reactions, and at least two distinct light-producing processes.

A typical reaction of this type is the oxidation of phosphorus, one of the oldest chemiluminescent reactions observed with a definite substance. Although the chemiluminescence of fireflies, decaying wood, and certain bacteria and fish have long been commented on, and were formerly attributed to the action of vital forces. The name phosphorus arose from a confusion of chemiluminescence with the phosphorescence of the impure barium sulphide, the so-called lapis Bologniensis. We may symbolise the fact that the reactions proceed in branching chains in a number of ways; thus denoting the reactants by A_2 and B_2 and the molecules in the excited state by A_2', we might postulate as the mechanism :—

(*a*)

$A_2' + B_2 \rightarrow A'_2B_2 \rightarrow (A'B)_2 \rightarrow A'B + AB'$

$AB' + A_2 \rightarrow AB + A_2'$

(*b*)

$A_2 + B_2 \rightarrow AB + A + B$

$A + B_2 \rightarrow AB + B$

$B + A_2 \rightarrow AB + A$

In both cases the conditions that one elementary reaction shall produce at least two reacting molecules, so as to effect an auto-accelerated reaction, are fulfilled, but whilst in the first the chemiluminescence is imagined to result from the return of the excited species AB' or A_2' to the normal, in the second it is supposed to take place through some type of atomic combination, *e.g.* $2A \rightarrow A_2$ or $A + B \rightarrow AB$, a mechanism which has been more fully investigated in a series of reactions which we shall have occasion to discuss later.

We may note that in addition to these types of chain mechanism there exists a third, in which it is imagined that a certain number of reaction centres are formed, by some identified as ions; around these reaction centres reaction takes place, and more reaction centres are formed. As a hypothetical case we might imagine that in a hydrogen chlorine mixture a positive ion is formed; around this ion a number of hydrogen and chlorine molecules are held by electrostatic forces. On neutralisation of the ion the energy set free effects the combination of the small group of molecules around the ion, chemiluminescence and the formation of a few more ions results .

That in the oxidation of phosphorus and of sulphur, and probably many other substances, the chemiluminescence is the result of some such type of chain mechanism can scarcely be doubted, but it is difficult in fact to state to which of these three possible types any one reaction definitely belongs. It is perhaps significant that in the oxidation of phosphorus a number of the lines in the complex band spectrum of the emitted light are identical with those of ionised oxygen. A typical phenomenon observable in the chain or cluster reactions is that of inhibition by small quantities of inhibitors. We may note the ease with which inhibitors such as benzene and ether inhibit the glow of phosphorus, a confirmation of the nature of the chemical process at work. Many other vapours exhibit chemiluminescence on oxidation, a fact noted by Sir H. Davy; thus the vapours of ether and carbon disulphide can readily be caused to undergo cold luminous combustion. Under more restricted conditions the union of acetylene and chlorine and the oxidation of the hydrocarbons can be made to exhibit chemiluminescence, and although in these reactions the thermal changes are relatively large, yet since the light emitted is definitely chemiluminescent it seems almost certain that, contrary to the views of several investigators, in these reactions, one cannot be dealing exclusively with thermally accelerated as opposed to branching chain or cluster accelerated reactions; excited molecules, atoms or reactive centre clusters must be taking part in the reaction.

Far more complicated but equally beautiful are a number of chemiluminescent reactions taking place in solution. The absence of a draught-chamber precludes one from showing the well-known Wedekind reaction, the interaction of chloropicrin and phenyl magnesium iodide exhibiting a green chemiluminescence; but the cold oxidation of pyrogallol formaldehyde mixture exhibiting an orange-red light, due to Trautz and Schorigin, blue luminescence in the oxidation of three aminophthalic hydrazide, and the green of triphenyl glyoxalin (Lophin), are all brilliant and readily demonstrated. These reactions are characterised by a high

temperature coefficient, some 2-3 for a rise of 10° C., an indication of the chemical origin of the light-emitting system.

It is somewhat remarkable that few people have observed the beautiful chemiluminescence exhibited by the interaction of chlorine or chromyl chloride with ammonia, although I suppose the former reaction is demonstrated annually in at least one of the classes in all schools where chemistry is taught.

Sir James Dewar, in this Institution, noted a chemiluminescence when ozone was brought into contact with organic matter. Such chemiluminescence is particularly marked in the oxidation of certain dyestuffs both fluorescent and non-fluorescent; we may observe the phenomenon in a brilliant form in the case of alcoholic solution of both eosin and safranin. The chemiluminescent light is not identical with the fluorescent light of these dyes. This reaction may be modified so as to give a very vivid demonstration of the action of inhibitors. By adding a small quantity of hydroquinone to the alcoholic solution of safranin, we note that on exposure to ozone no chemiluminescence results, the dyestuff is not oxidised, but after a minute or two the hydroquinone is completely oxidised, and the brilliant green glow of the dyestuff undergoing oxidation spreads over the bulb.

We have already indicated the possible connection between chemiluminescence and reversed photochemical action postulating in both cases the generation of an excited molecule formed in the former by chemical and in the latter by radiant processes. This analogy may be pursued somewhat further by a consideration of the mechanism of photochemical sensitisation and its reversal In cases of photochemical sensitisation a molecule excited by the absorption of radiation conveys by collision part or all of its energy in a molecule of another species, which subsequently undergoes chemical reaction. The beautiful experiments of Frank and Cario in forming chemically reactive hydrogen by sensitisation with mercury vapour excited by the line λ2537 A° may be cited as a case of photochemical sensitisation. A similar complimentary reaction in chemiluminescence has been observed by Kautsky, who showed that the energy liberated as chemiluminescence in the oxidation of the suboxide of silicon, siloxene, could be transferred to certain dyestuffs, causing them to become excited and undergoing fluorescence. Only those dyestuffs such as fluorescein and eosine, which are absorbed by the crystals of the siloxene, can be made to fluoresce, an indication that the energy necessary for excitation of the dyestuff molecule must be transmitted by collision from one of the surface molecules of the solid reacting siloxene which in turn must pass through the stage of an excited molecule during oxidation. The experiments initiated by Haber and Zisch on the interaction of the alkali metals with halogens and halides have more recently been re-examined by numerous investigators, notably Kondratjew, Ljallikoff and Polanyi; these all exhibit beautiful chemiluminescent effects. The interaction of sodium and iodine vapour, and of potassium and iodine demonstrate the various phenomena to be observed in these reactions, and analysis of the radiation emitted as well as of the distribution on the tube walls of the salt formed, gives us a clue to the mechanism of the reaction. In the interaction of sodium vapour and iodine we may compute the thermal changes accompanying all the possible reactions.

(1) $Na + I_2 = NaI + I + 33.5$
(2) $Na + I = NaI + 68.7$
(3) $Na_2 + I = NaI + Na + 51$
(4) $I + I = I_2 + 35.2$

It is observed that the D line is only emitted corresponding to a chain luminescent emission of 48.3 cals. Of the four reactions listed above only two are accompanied with sufficient energy for the liberation of the D line, viz. (2) and (3). A further observation that the chemiluminescence possesses in this case a negative temperature coefficient suggests that only one of these reactions, *viz.*, $Na_2 + I = NaI + Na$ is responsible for the chemiluminescence observed in the gas phase, and that neither (2) nor (4) take place in the gas phase except in a reaction more involved than a bimolecular one. The tube walls catalyse both reactions (2) and (4) effectively. The surface catalysed reaction is clearly observed in the union of potassium and iodine for the reaction (3) does not occur to an appreciable extent when sodium is replaced by potassium on account of the low concentration of diatomic potassium molecules in the vapour of the element.

The bulk of chemiluminescent processes can accordingly be represented as

$$Na_2 + I \longrightarrow NaI' + Na$$
$$NaI' + Na \longrightarrow Na' + NaI$$
$$Na' \longrightarrow Na + h\nu$$

Chemiluminescent methods may be employed not only to identify, as noted above, the nature of the molecular processes involved in a chemical reaction, but also to affix within certain limits at least the energy

of dissociation of certain gases. Thus, simple dissociation process

$$H_2 \rightleftarrows 2H$$

in reality must be much more complicated in operation than the unimolecular bimolecular dynamic equilibrium postulated by this equation given in the text books. Whilst the efficiency of collision in causing reaction of complex molecules such as $2NO_2 \rightleftarrows N_2O_4$ is usually high that of atomic recombination is very low, and if we regard a pair of normal atoms in close proximity to one another as the extreme case of dissociation, the absence of an electric moment in the system forbids the quantised emission of radiation. Thus reactions such as $2H \rightarrow H_2$, $2Br \rightarrow Br_2$ only occur in the presence of a third body or a surface, and the energy of combination transmitted to the third body is frequently emitted as chemiluminescence, a phenomenon readily observed with atomic hydrogen. The energy of combination of atomic hydrogen is found to be sufficiently great to excite the OH molecule to emission but not the mercury line λ2587A in mercury atoms; this places the energy of dissociation of hydrogen between 94,000 and 112,000 cals. per gm. molecule. Atomic hydrogen readily prepared by Wood's method is a convenient source of many chemiluminescent experiments. The afterglow of a number of gases, notably oxygen, nitrogen dioxide and nitrogen, when excited by the electric discharge may all be regarded as chemiluminescent reactions in that the bases possess enhanced chemical reactivity in the glowing state. The glow of nitrogen dioxide and nitric oxide, and the afterglow of Lord Rayleigh's active nitrogen are particularly brilliant, but the chemical processes involved are at present obscure. It seems at least definitely established that active nitrogen contains at least two chemically reactive species both atoms and excited molecules. The cohesion of solid surfaces may be regarded as a species of chemical reaction in the solid state and several of these reactions are found to be chemiluminescent, although frequently classified as tribo or crystaloluminescent reactions, the crystallisation of arsenious oxide, sugar, exemplify this class of reaction.

Other quasi-chemical reactions which are luminescent include the fluorescence and phosphorescence excited in various substances, especially in solid solutions by electron bombardment, some of the effects produced by the bombardment of minerals such as kunzite, by high speed electrons, are particularly brilliant. Finally, we may observe the chemiluminescence obtained with certain bacteria such as B. fluorescens, and the reaction between luciferin and luciferase, the basis of biological light.

VELOCITY OF WATER FLOW AND CORROSION.

A very instructive illustration of the influence of velocity of water flow on the rate of corrosion of steel tubes was seen at a recent gathering of members of the Institution of Civil Engineers. The demonstration was made by Major J. N. Dundas Heenan, and the apparatus comprised an arrangement of tanks and pump which maintained a steady flow of water through a ¼in. nozzle on to the centre of a polished steel plate. This plate was first cleaned with ether to remove all traces of grease. The water was discharged from the nozzle at about an inch above the plate and thus flowed radially in all directions over the plate, decreasing in velocity with increase in distance from the centre.

Clearly visible was the point of transition from turbulent flow, to one of stream-line flow, this point being marked by a definite wave, as shown in the accompanying illustration, Fig. 1. It was soon noticed that where the water was in stream-line flow, on the plate outside the wave diameter, small bubbles formed and remained, whereas on the surface of the plate inside the diameter of the wave, where the water was in turbulent flow, no bubbles adhered to the plate's surface.

After the lapse of a few hours the outer diameter of the plate started to corrode, while the inner diameter showed no traces

Fig. 1.

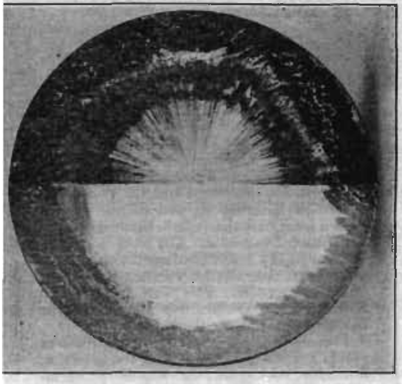

Fig. 2.

of corrosion. The explanation of this is that where the water is in turbulent flow the small bubbles of oxygen are swept away and therefore cannot act on the metal. When the velocity of the water has fallen below that required for turbulent flow and stream-line flow occurs, the bubbles are not swept away, but cling to the plate surface, where they corrode.

The same experiment was made in order to determine the most suitable velocity of water flow to avoid internal corrosion in the steel tubes of the Foster economiser. It clearly demonstrated that the flow of water through the tubes of an economiser should be above the critical velocity so as to give turbulent flow, and permit the scrubbing action of the water to prevent the small bubbles of oxygen from adhering to the internal surface of the tubes and damaging them.

Fig. 2 shows a plate which has been subject to this experiment for 170 hours. Half of the plate has been brushed to remove the surface oxide and shows clearly the corrosive action of air on the area of stream-line flow.

AUSTRALIAN TRADE.

The total value of the goods imported and exported by Australia during May was £10,996,945 and £9,857,912 respectively.

COAL PETROL DEVELOPMENT.

" You know what it will mean when this country is able to produce its own oil," said Sir Samuel Instone in proposing the toast of " Low Temperature Carbonisation, Ltd., and Doncaster Coalite, Ltd.," at a luucheon given in Doncaster on July 5, prior to the official opening of the new coalite carbonisation works at Askern Colliery.

There are untold millions sterling going abroad annually for oil and benzol," he continued. " Those in the colliery business and all those present will realise the importance of being able to produce enough to supply ourselves. Those in the colliery business also know what it means to be able to find ready outlets for the small coal which we are going to use in the process of low temperature carbonisation. There are representatives of the miners here to-day, and they will know that if the collieries can dispose of their small coal it means prosperity for the mines and work for the miners."

Lieut.-Col. W. A. Bristow, Managing Director of Low Temperature Carbonisation, Ltd., replying to the toast, said that the first step towards restoration of mining prosperity must be realisation of the inherent value of the raw coal itself. " How absurd it seems," he continued, " to be burning in the firegrate the oil and petrol contained in British coal for which the miner and the mine owner received jointly about 1s. per cwt. and replacing it with imported petrol sold to the public, less tax, at about 19/6 per cwt." In addition there was a stupendous loss in selling millions of tons of small coal at far less than its true heat value, while it was tragic to be exporting hundreds of thousands of tons of such coal at a price below the cost of production while the householder in London is paying 50s. a ton for coal of the same heat value.

Liquid Treasures of Raw Coal.

Colonel Bristow, continuing, said that by the coalite carbonisation process there was obtained from each ton of coal about 18 to 20 gallons of crude oil and 2½ to 3 gallons of petrol. The crude oil could be distilled or cracked to yield a further quantity of petrol and a yield of fuel oil and other products which would fetch a price higher than the cost of the coal.

Coal Petrol the Best.

It was a most remarkable fact, declared Colonel Bristow, that petrol made from coal was actually superior to petrol made from crude petroleum. The situation with regard to crude oil had for some time been under a cloud, owing to the fact that large scale

production preceded development in distilling and cracking processes, and resulted in a serious fall in the price of tar products. This position had now been remedied. A complete distillation plant of the most modern type would be finished at the coalite works at Barnsley by the end of the month, while arrangements had been made for cracking crude oil on a commercial scale at the works now being erected by Petroleum Refineries, Ltd., at Killingholme on the Humber. The completion of this development works would establish a free market for the oil products at much better prices than those hitherto obtained and the provision of a vast quantity of home-produced oil in lieu of the imported article. This would have a tremendous effect upon the prosperity of the mining industry and upon the unemployment problem and the question of national safety.

No Risks of Oil War.

" Some people seem to think," continued Colonel Bristow, " that the development of the home oil market must be accompanied by fierce revolutionary warfare with the existing British oil companies and that one side or the other must perish in the struggle. Nothing, however, could be further from the truth, and there already exist the most happy working arrangements between the oil trade and those producing motor spirit from coal. I am assured from every responsible quarter that refineries in this country will welcome any home-produced crude oil, and if in the fullness of time they find themselves taking a very large percentage of home-produced oil it will place them in a much safer position all round. I should like to take this opportunity of thanking the Anglo-Persian Company for the assistance they have given in the refining and preparation of some of our first coal petrol and for the sympathy they have always shown towards our programme. Such treatment is typical of the attitude displayed by the responsible men in the industry, and I see no reason whatever to fear internal hostility towards the production of British crude oil."

The ultimate output of the new plant will be 127,000 tons of coalite smokeless fuel per year and 8,781,000 gallons of oil and petrol per year. Only one half the total number of retorts have yet been erected, and these will produce in addition to coal oils about 250,000 gallons of crude spirit scrubbed from the gas.

ROTHAMSTED (HARPENDEN) EXPERIMENTAL STATION.

Varied, Interesting and Useful Activities.

Work in Progress, 1929-30.

An interesting booklet issued by the Station gives a good deal of interest and information about the work carried on in connection with plant life. It states that the subject of the investigations is the growing plant in health and disease, and as a necessary corollary, the soil, and the purpose is to obtain information, and to put this in such a form that the expert, the teacher and the grower can use it. The work is not restricted to any set of local conditions, but is on so broad a basis that the information has value everywhere. This wide scope makes Rothamsted a centre, not simply for the British Isles, but for the Empire.

The conditions necessary for the growth of plants are six : Water, air, temperature, nutrients, root space, and absence of harmful conditions—all these are included in the programme. Abnormalities of growth resulting from excess or deficiency of any of these factors are studied and also the parasites and other agents detrimental to the plant and their relationship to the plant in various conditions of nutrient or water supply and environment.

Nutrients, being historically associated with Rothamsted are, therefore, considered first. Nitrogen for 85 years was the prime subject of research and still remains one of the most important.

(1) The form in which nitrogen is taken by the plant is being re-investigated by Dr. Crowther and Dr. Richardson. The need for this arose out of the observation that cyanamide and sulphate of ammonia gave approximately equal results, even though the cyanamide caused a marked depression of nitrification while sulphate of ammonia did not.

(2) A fuller study is being made by Dr. Crowther and Dr. Mukerji of the nitrification process in soils, starting out from present-day knowledge of the microbiological, chemical and physical conditions in the soil. Special attention is being given to the effects of aeration and alternate wetness and dryness, this being a common feature of British conditions and one known to re-act considerably on yield and composition of the crops. (See barley.)

(3) The influence of the growing crop and of the ploughing in of green crops on nitrification is being studied on the green manure

plots at Woburn by Dr. Crowther, Dr. Mann and Mr. Michandani.

(4) Nitrogenous Fertilisers. The enormous extension in the production of nitrogenous fertilisers from the air has completely altered the situation so far as these are concerned and much fuller experimental work is now being carried out to discover :

(a) The detailed effects and relative agricultural values of the different substances now available.

(b) The influence of quantity of nitrogen and time of application on character of growth, composition and quality of crop, and yield.

This work is done in the field and pot culture house—the detailed growth measurements by Mr. Clapham and the laboratory work by Dr. Richardson.

Among the special fertiliser effects to be studied are those of muriate of ammonia in increasing the yield and improving the quality (by lowering the nitrogen percentage) of barley. The decomposition of cyanamide in the soil is being further studied. It is now known that the older idea of decomposition to urea, then ammonia, then oxidation to nitrate is inadequate, there being an inexplicable delay in nitrifiration even after all the cyanamide is decomposed.

(5) Phosphatic Fertilisers. The behaviour of superphosphate on acid soils is being investigated by Dr. Crowther and Mr. Pugh, to ascertain whether the phosphoric acid is all retained by the soil, as on the neutral Broadbalk plots already studied, or whether the absence of calcium carbonate brings about a new result.

The work on basic slag is being continued by Mr. Warren.

Dr. Brenchley has confirmed Gericke's results that phosphate is most needed in the early stages of plant life. This is likely to explain a good deal of the difficulty in interpreting the complex effects of season on phosphate deficiency. In the Botanical Laboratory the effect of other nutrients is being tried.

(6) Potassic Fertilisers. The beneficial effects of potassic fertilisers in sunless seasons and their occasional apparent harmful effects are being further investigated, as also will their effects on the sugar content and yield of sugar beet and on the yield and quality of potatoes.

(7) Water Supply. This is one of the most important problems in agriculture and of especial importance to the British Empire. It is controlled in dry regions by irrigation and in all regions by cultivation. In dry regions the object of cultivation is to have a firm bed below and a loose layer or mulch of soil on the surface; in wet regions the purpose is to make a way out for excess of water and to produce a good tilth, which is, as a rule, associated with satisfactory conditions of water and air supply to the plant root.

The wet region conditions are, on the whole, of most interest to British farmers; the investigation of the relations between soils and water is done in the Physical Department under Dr. Keen. The work falls into two main divisions :

(a) Field experiments on cultivation processes and their effect on the soil. This work is done by Mr. Cashen in conjunction with Dr. Keen, and much use is made of a recording dynamometer that provides data for subsequent working up in the laboratory. In addition to the effects of standard implements a study is being made of rotary cultivation, a process that aims at producing a seed-bed in one operation.

(b) Laboratory investigations of the physical and chemical factors responsible for the production of tilth in soils. This work is conducted by Dr. Keen, Dr. Schofield, Mr. Scott Blair and Mr. Cashen, and includes (a) studies of flocculation in weak suspensions of clay (a process having suggestive analogies with the formation of tilth), (b) the plastic behaviour of thick clay and soil pastes, and (c) the cohesion and plastic properties of moist soil. In addition, studies are made of the relation between meteorological data and the temperature, moisture content and drainage of the soil, using for this purpose the extensive range of self-recording instruments installed at the meteorological station.

The addition of water to soil, however, not only increases the supply available for the plant, but also acts on the soil itself. Three distinct types of change are produced : (1) in cool conditions the water tends to contain CO_2 and other acids; these remove the calcium and other bases from the clay complex and replace them by hydrogen, giving an acid clay and ultimately a soil containing much SiO^2; (2) in arid conditions where, as often happens, there are deposits of sodium chloride, or a certain amount of it in the soil, the sodium replaces the calcium, giving a sodium clay quite different in character from the calcium and less amenable to ordinary cultivation processes, with a strong tendency to the formation of alkaline conditions; (3) in hot and wet conditions some K_2CO_3 apparently forms which dissolves out the silica, leaving the Fe_2O_3 and Al_2O_3, and forming laterites.

The two first types are closely related and are being studied—especially the first—in the Chemical Department, by Dr. Crowther, Mr. Basu and Miss Heintze, and the physical properties of some of the clays, other than calcium clay, are being studied in the Physical Department. This work will throw much light on soil acidity, of great importance in northern climates, and especially capable of investigation at Woburn, where there are some attractive acid plots; it will also throw light on soil alkalinity and on the agricultural value of sodium clays, both of which are of great importance in irrigated regions. Miss Heintz has already shown that the quinhydrone method of estimating hydrogen ion concentration breaks down for some tropical and some English soils, including one at Rothamsted, possible as the result of oxidation of the quinhydrone by the soil, and this reopens the question of determination of pH values.

(8) Composition of Crop. It has already been pointed out that variations in nutrient supply or other environmental factors alter the habit of growth and the composition of the crop. The chemical work is done by Mr. Bishop for barley, and by other members of the Chemical Department for sugar beet and potatoes; the field observations by Mr. Clapham, and the general relationships between growth and weather conditions are worked out in the Statistical Department by Dr. Fisher and Dr. Wishart, while the still more widespread meteorological data and crop observations at a number of outside centres are worked up by Mr. Irwin.

Most work has been done on barley. It has been shown that the grain, as it grows, is swelled by nitrogenous and non-nitrogenous material flowing in at even rates, so that the proportion of nitrogen remains constant all through its growth, except in the very early stages. The proportions between these two are settled in the very early days of the plant's life, and one of the most interesting things that has come out of the investigation has been the possibility of predicting the nitrogen content of the final grain from an examination of the plant in June.

Further, it is shown that the nitrogen compounds, while complex, are present in certain definite proportions which are closely connected with the percentage of nitrogen in the grain. As the nitrogen increases the proportion present as hordein increases, the proportion as glutelin remains constant, and that as salt soluble compounds decreases. It is immaterial whether the nitrogen is increased by soil factors, climatic factors or supplies of artificial fertilisers. The proportions seem to be constant for each variety and there are indications that the ratio glutelin/nitrogen is an important varietal constant. As an extension of this research attempts are being made by the Institute of Brewing officers to ascertain the value of hordein, glutelin and the salt soluble compounds in malting and brewing, and their relation to the growth of yeast.

The seasonal factors determining the percentage of nitrogen and therefore the proportion of nitrogen compounds appears to be second in importance to the soil factors. Soils supplying much nitrate in early spring tend to give high yields and those producing much nitrate in summer to give high nitrogen percentages in the grain. Late sowing increases the nitrogen content of the barley and high rainfall in April decreases it.

The phosphorus content of the grain varies much less than the content of nitrogen. It is apparently depressed by nitrogenous manuring. Attempts are being made to discover in large scale experiments the influence of the phosphorus of the grain on the stimulation and nutrition of yeast, and on the buffering and reaction during brewing.

These barley investigations have been made in conjunction with the Institute of Brewing, who have arranged during the past four years for large scale maltings of the experimental barleys, from which it has been possible to obtain much information as to the value of analytical methods, and, in particular, to assess the significance of some of the empirical methods hitherto used. This work will assist investigators in the future by showing them the relative importance of the various methods in their analytical and research technique.

Last year, for the first time, it was possible to arrange for experimental brewings of the malts and for expert sampling of the resulting beers. No difference in taste of practical consequence was found.

This work on the effect of rainfall, temperature and nutrients on plant growth and plant composition is steadily being linked up with the plant physiological investigations of Dr. Gregory, Mr. Richards, and the staff of the Imperial College. This is, perhaps, the best instance of co-operation between research institutes in the country. We are hoping that the work will gradually link on to investigations on plant disease.

The Woburn data are being worked up by Dr. Mann, Mr. Mirchandani, Dr. Voelcker, and others.

These detailed studies of the effect of external conditions and of nutrients on plant growth will, it is hoped, enable us to draw up lists of diagnostic symptoms that will enable us to say from an examination of the plant what particular factors are present in excess or what are deficient. This will be a useful and, it is hoped, trustworthy method of analysing a soil by means of the crop.

In all the experiments hitherto considered, one crop only has been grown; the problem has been reduced to its simplest. Every other kind of plant is in principle eliminated, though, in fact, many weeds always remain. In one very important crop, however—the grass crop—this restriction does not hold. A number of species are grown together, thus bringing in the element of competition.

Competition between weeds and arable crops has already been studied by Dr. Brenchley and the Botanical Staff; competition between the various grasses and clovers in the grass field is now to be investigated by Mr. Clapham and Mr. F. J. Richards.

(9) Leguminous Plants. The special position of leguminous plants in plant nutrition has long been recognised; it is associated with the organism present in the root nodules. These organisms do not always occur naturally in the soil. Mr. Thornton's inoculation investigations carried out for several years, and last year at 89 centres all over the country, have shown that after inoculation lucerne can be grown as well in the north and west of the country as in the south-east. The important practical question remains of comparing ducerne sown in spring with a cover crop and ducerne sown in summer without it.

There was a large demand for cultures last year, which will, no doubt, continue this year.

Much physiological work is being done on the organism and on the nodule. The formation of the nodule does not begin till the true leaves are put forth; the two events seem to be closely associated. Whatever the relationship between them, it affects the surrounding medium also, for in sand cultures the solution in which lucerne seedlings with open leaves are growing stimulates growth of *Bacterium radicicola* more than the solution from a culture in which the true leaves are not yet formed. This is to be followed up.

Each organism is specific to certain groups of leguminous plants. Plants of one group can, however, be grafted on to plants of another, and this experiment is to be made to discover whether the root or the leaf is more closely associated with the specific character of the organism.

(10) Soil Microbiology. — Fundamental Work.—Bacteria. Mr. Thornton and Mr. Gray are developing their new method of counting bacteria in the soil. The counts formerly made at Rothamsted used to show about 10 million organisms per gram; it was, of course, realised that these numbers were far below the truth. Counts made by the new method show 3,000 million per gram, but these include dead as well as well as living organisms. The method is rapid, and it allows of a resumption of the study of fluctuations in numbers; it is shown that the numbers fluctuate at least each two hours.

A study is being made of the effect of various substances added to the soil, one of the most important being farmyard manure, studied by Mr. Jensen, who is finding that the rapid accumulation of nitrate does not begin until a certain carbon-nitrogen ratio is attained.

In the Department of General Microbiology, Mr. Cutler and Miss Crump are continuing their studies on the decomposition of carbon compounds added to the soil; they show that the evolution of carbon dioxide is due to two causes, respiration of the soil population, which is the chief factor in poor soils, and fermentation processes, which become more and more important as the soil becomes richer.

Miss Meiklejohn is studying the decomposition of nitrogen compounds, particularly of peptone, both in the presence and absence of amœbæ.

Five applications of soil microbiology in practice are at present being studied :—

(1) Production of nitrates in soil resulting from the use of farmyard manure or other causes.

(2) Inoculation of leguminous crops.

(3) Microbiological methods of purifying the effluent from beet-sugar factories.

During the 1928-29 campaign an average purification of about 80 per cent. was recorded. Both at the factory and in the Laboratory at Rothamsted over 95 per cent. has been maintained for several weeks.

During the past summer extensive experiments by Mr. Dawson and Mr. Jenkins have shown how the greatest efficiency of the filter medium can be secured. Much work was also done in identifying and studying the organisms.

(4) Production of artificial farmyard manure by Mr. E. H. Richard. The importance of maintaining a satisfactory ratio of pentosans (furfural yielding substances) to lignin has already been emphasised; this year Dr. Norman is studying in detail the decomposition of the pectins, both chemical and micro-biological.

(5) The work on partial sterilisation is at the moment in abeyance.

(11) Plant Pathology.—Virus Diseases. A special grant having been made by the Empire Marketing Board, the nature of virus diseases is being studies from different points of view by a group of workers. Dr. Henderson Smith is examining the more general problems of discrimination between different viruses, and their properties; Dr. Caldwell is paying special attention to the movement of virus about the diseased host plants and its relation to environmental conditions; Miss Hamilton is concerned with problems of insect transmission of the disease; and Miss Sheffield is examining the minute structure of diseased tissues in comparison with those of healthy plants. The work is carried out largely on potatoes and tomatoes.

Bacterial Diseases. Mr. R. H. Stoughton is studying the " Black Arm " disease of cotton, caused by *Bacillus malvacearum*. In particular he is tracing the effects of temperature and humidity on the progress of the disease, and the life history of the organism within and without the plant. The control chambers, in which the work is done, have been erected out of a grant from the Empire Marketing Board. The investigation is bringing out some interesting relationships between environmental conditions and disease attack, and it is further showing the extent to which diseases of tropical plants can be studied in home laboratories where the work can often be done under more exactly controlled conditions.

Fungus Diseases. Dr. Brierley is continuing his work on the physiological and genetic analysis of fungi and the study of virulent strains. The wart disease investigation will continue on two different lines; numerous solanaceous plants are being tested for susceptibility towards both the winter and summer sporangia, and the incipient infection of so-called " immune varieties " will be studied in detail.

Entomology. Dr. Imms is making an extended study of the nature and extent of the control exercised by idigenous parasites and predators over the chief agricultural pests; parasitism being one of the most important natural agents controlling insect life. Specific cases are being worked out in detail by the Staff of the Department. The parasites of the Frit Fly are being studied and also the incidence of their destructive action on the fly in relation to time of sowing of the host plant.

Dr. Barnes, in addition to his general work on the gall-midges affecting osier willows, wheat and meadow foxtail, is also investigating the incidence of parasitism in relation to its biological effect upon them.

Dr. Imm's earlier work on the response of insects to chemical attractions and the factors which govern this kind of behaviour is being followed up by Mr. Newton. The subject offers prospects of practical application, especially with reference to species of insects for which there is no reliable control method.

(1) Insecticides. This year's work is devoted mainly to Pyrethrum.

(a) Studies of the flowers obtained in successive crops at Harpenden to see if there is any falling-off in yield or toxicity.

(b) Studies of the effect of time of flowering and size of flower head upon toxicity.

(c) Studies to ascertain whether Pyrethrum loses its toxicity with time, and if so, why; and whether the loss can be prevented.

(d) Studies of the effects of Pyrethrum on insects. Some insects are not killed, but affected by narcosis, and then recover. Attempts will be made to stop this recovery.

(13) Bee Research. (Mr. Morland). The programme accords with recommendations of the Bee Research Committee, *viz.* :—

(a) Feeding experiments on the relative values of cane and beet sugar as winter food.

(b) Experiments at Kimpton Hoo on the Warm and Cold Way problem.

(c) The temperature records are being examined by the Statistical Department to see how far it is desirable to continue this line of research.

(d) Mr. Morland is familiarising himself with the technique of controlled mating, particularly with the Watson method of Artificial Insemination, with a view to attacking the problems of inheritance in the bee.

GENERAL NOTES.

THE RAYON INDUSTRY.

The rayon industry began by the production of fashionable trifiles, but it is now firmly established in the manufacture of wearing apparel.

From the limited field of stockings and underwear its uses have extended to the whole field embraced by the term "soft furnishings." Rayon is at once the ally and the rival of both cotton and wool, and may compete or unite with either in tapping the large potential demand for fabrics which shall range in colour and design over a much wider field than the orthodox products of the older textile industries. The rate at which this new textile industry may exploit its opportunities is obviousy determined by the growth of technical knowledge and the mastery of certain economic problems.

In cotton and wool textile technology the essential feature is the manipulation of a given natural fibre. The emphasis has rested, therefore, on the operation of machinery, the structure of cloths, and the study of design in relation to the mechanical possibilities of the loom. In ray production chemical knowledge is the foundation of the skill required, and this must influence the whole curriculum of the prospective rayon worker. Training operatives *ad hoc* is likely to become an important branch of textile technology, but the progress is not likely to be rapid until the scientific experts and the engineers have mastered more completely the vagaries of this new filament. There are from my technical friends that there are still many thorny problems to be tackled in the devising of machinery alone, quite apart from the fact that the certainty of always producing first-grade filaments is not yet within reach. This is an extremely interesting position to students of industrial economics. The market for a reliable product is practically unlimited, but the successful exploration of that market is held in check by the necessity of large-scale (and costly) experimental production and the enforced special recruitment and training of the operatives to staff the factories. Here, surely, is a splendid opportunity for our technical schools, especially as the rayon industry is much more widely scattered than the strongly localised wool and cotton industries. The Balfour Committee pointed out that the raw materials from which rayon is made are readily transportable and the making of rayon is not limited to areas with particular climatic conditions. Wherever plant may be set up and competent staffs engaged the industry may be established. In a remarkable way rayon production has broken through the older conceptions of localised industrial activity, but it may be questioned whether our technical training throughout the country has been adapted sufficiently to make the most of this new form of localisation.

FIELD WORK OF THE CANADIAN GEOLOGICAL SURVEY.

The Deputy Minister of Mines, Canada, announces that the Geological Survey will have more than fifty parties in the field throughout the Dominion, engaged in survey and investigational work, during the summer of 1929. One party will go to Yukon, two to the North-West Territories, ten to British Columbia, seven to Alberta, five to Saskatchewan, four to Manitoba, seven to Ontario, nine to Quebec, three to New Brunswick, four to Nova Scotia, and three will conduct investigations of general interest. The personnel of these parties comprises about 250 persons, of whom forty are permanent officers of the Geological Survey; thirteen are University teachers or specialists obtained from other institutions; one hundred and thirty are students of geology and engineering from the various Canadian universities; and the remainder comprises cooks, packers, canoemen, and other field helpers.

Eleven topographical parties will be making topographical maps required as a basis for geological work. These topographical maps ,like most of the geological maps, are being made in units of uniform dimension, scale, form, and standard of precision, so as to be contributary to a primary map system for Canada and are conformable with similar contributions to this primary map system that are being made by other branches of Departments of the Dominion Government engaged in topographical survey work.

Several of the geological parties will be engaged in exploratory work in remote regions. Construction of the Hudson Bay Railway to Churchill has rendered it comparatively easy for the Survey to send one party to an area near Chesterfield Inlet. Another party will be sent by aeroplane to a mineralised area in Northern Saskatchewan that otherwise could only have been reached by weeks of travel by canoe. Parties sent into little known parts of northern Canada will survey lakes, rivers, and topographical features; will investigate the geology and mineral possibilities; and

will collect information about water powers, forest and plant growth, climate, wild animals, etc. The majority of geological parties, however, working nearer railways and other means of transportation and industrial development will be located in mineralised areas such as the Coast Range batholith in British Columbia and Yukon, the foothills of the Rocky Mountains, and the Canadian Shield, for the purpose of ascertaining the extent and geological relationships of the mineral deposits and of mapping the rock formations.

Each year a few geological survey parties are occupied with special investigations. The problem of domestic water supply is increasing in importance with the growth of population and the development of industry, especially in the Prairie Provinces, and this year one party will investigate the underground water supply around Regina, Saskatchewan. Methods of locating minerals by means of their electrical magnetic, and other physical properties is another major problem that is being given attention by the Geological Survey. In 1928 the Survey commenced a study of the applicability of these methods to Canadian conditions, and in 1929 two field parties will be engaged in further investigations. Canada affords one of the largest and most promising fields in the world for the use of methods of electrical prospecting.

THE MECHANISATION OF THE MINES.

A great deal is constantly heard of the need for every possible improvement in the technical and mechanical equipment of our coal mining industry, but the public is perhaps unaware of the great progress that has been made in this direction in recent years, or of the constant efforts that are being made to extend and improve the mechanisation of the mines. An example of what is being done is, however ,provided in the report* issued on June 28 of the special committee appointed by the Yorkshire coalowners.

The report, which deals not only with Yorkshire but with the whole country, is particularly opportune at the present time in view of the keen competition for available coal markets at home and abroad; and the coal owners are to be congratulated upon the very exhaustive enquiry their committee has made and upon the clear statement of the advantages and disadvantages of mechanical underground conveying in seams varying from 1ft. 10ins. to over 8ft. in thickness in the principal coalfields of Britain.

THE EFFECT OF MECHANISATION ON

Two points stand out strongly from the report :—

(1) The increase in mechanical conveying during the last few years and since the termination of Government Control.

(2)The effect of mechanisation upon employment.

In 1921 there were only 301 conveyors in use at the coalface in Great Britain. In *1928 the number had been increased to* 2,100.

The prime object of the utilisation of underground machinery for getting and loading coal is to reduce the labour required to produce a given quantity of coal, and so reduce the labour cost.

By what is known as " Intensive Mining " (where the operations of cutting, shotfiring, filling, ripping, packing, timbering and moving forward the conveyor are performed in a definite sequence of co-ordinated operations the whole cycle being completed in 24 hours and a constant output obtained from a definite length of face) very remarkable increases in output have been obtained. An example is given where the output *per man per shift delivered to the main* haulage was increased from 1.9 tons to 4.0 tons. Other instances are given showing that whereas by the old method of hand getting and hand filling into tubs, it took 82 manshifts to produce 100 tons, with machine cutting and conveyor loading it only required 39 manshifts to produce the same tonnage. In another case the number of men employed has been reduced from 2,400 with the old method to 1,890 under the present system for the production of exactly the same output of coal.

The effect upon cost of this increase is, of course, very great but the effect upon employment of such improvements in technical efficiency are frequently overlooked by the public, which is apt to regard unemployment in the coal industry as evidence of inefficiency, when it is often exactly the reverse.

An Exhibition of architectural drawings calculated to prove of interest to the public

* Report of an Investigation of the Underground Conveying and Loading of Coal by Mechanical Means by a Special Committee appointed by the Midland Institute of Mining Engineers, the South Yorkshire Coal Trade Association and the West Yorkshire Coalowners' Association. Price 6s.

as a whole and more especially to shop and store keepers and other business men who contemplate the erection of new business premises on modern and original lines, is announced.

The Exhibition was of designs submitted in a recent competition inaugurated under the auspices of the Incorporated Association of Architects and Surveyors for the front of a typical commercial building, and was held at that institution's headquarters, 1, Wilbraham Place, Sloane Street, London, S.W. from Wednesday, 10 July to Saturday 20 July (open daily, excepting Sundays, from 10 a.m. to 5 p.m.

Present day street architecture has often become standardised to such an extent that a design ranks as good architecture but bad business; in other words, the commercial man finds his new building dignified and well-proportioned, but too reticent and too much like his neighbours for his liking.

The competition, which has aroused considerable interest in the allied circles of architecture and surveying, as evinced by the number of drawings submitted, had as its purpose the encouragement of new thoughts on the old problem of the combination of sane architectural treatment with the spacious windows and distinctive façade so essential to the occupier of modern business premises.

A cash prize of firty guineas was offered for the design ultimately selected by the Assessors of the Competition who were Messrs. Maurice B. Adams, F.A.I.B.A. and Alexander MacLean, M.A., R.B.A. (Vice-President of the Royal Society of British Artists), and H. Gordon Selfridge) Founder and Chairman of Messrs. Selfridge & Co., Ltd.

The prize was awarded to Mr. Keith D. P. Murray, A.R.I.B.A., and the Association's medal to Mr. R. J. Duke, A.I.A.A., and Mr. F. E. F. Atkinson, the 2nd and 3rd awards respectively.

PUBLICATIONS RECEIVED.

U.S. BUREAU OF STANDARDS.

Code for Protection Against Lightning. Price 25 cents.

United Strip and Bar Mills (Sheffield).—Catalogue of goods with analyses and tests (tensile strength, etc.), of individual products.

On the occasion of the 50th anniversary of its existence the Lindès Ice-Machine Co., of Wiesbaden, has published a handsome volume describing the history and development of this important Firm.

PHYSICAL CONSTANTS.

Having discussed in these columns the subject of physical constants (*Chemical News*, 1929, *138*, 228, 242, 257, 305), the following from the *Physical Review* of June, 1929, *32*, 1088, will be of interest:—Absolute wave-length of the $K\alpha$ and $K\beta$ lines of Cu. J. A. Bearden, University of Chicago. —Using plane optical gratings ruled with 50 and 600 lines per mm., spectra of the K series of Cu have been obtained. The $K\alpha$ lines were not resolved but the mean wave-length was found to be $K\alpha = 1.5439 \pm 0.0002$. This is about 0.36 per cent. higher than given by crystal measurements. The $K\beta = 1.3940 \pm 0.0002$, which is about 0.34 per cent. higher than the crystal measurements. The $\pm$ values given are the probable errors obtained in taking the average of 10 plates. All of these plates were taken under different conditions and many of the plates had 8 measurable orders. The angles were measured by using two plates, one 8 cm. from the grating and the other 205 cm. from the grating. The plates were parallel to within 5 sec. of arc and the distance between them was measured to one part in 50,000. The gratings were centred over the axis of rotation of the spectrometer by the use of an interferometer. The interferometer was also used to make sure that the grating did not move during an exposure. The measurements of the distance between the plates and the separation of the lines on the plates have been carefully checked by independent observers in order to find if there was a consistent error which was being overlooked. These results give a value of the electronic charge $e = 4.824 \times 10^{-10}$ and Avogadro's number $N = 5.999 \times 10^{23}$.

The high value for e is to be noted.

Bearden (*Proc. Nat. Acad. Sci.*, June, 1929, *15*, 528), gives revised values as follows:— $K\alpha = 1.5422$; $K\beta = 1.3926$; $e = 4.808 \times 10^{-10}$; $h = 6.604 \times 10^{-27}$; $N = 6.022 \times 10^{23}$. $1/\alpha = 136.6$; grating space of calcite 3.035A.

These unexpected values had caused the author to delay publication.

F. H. L.

SOUTH AFRICAN GOLD.

The Transvaal gold output for June was —Witwatersrand, 721,852 ounces; other districts, 34,677 ounces—a total of 856,029 ounces. The total for June, 1928, was 862,368 ounces. At the end of June, 1929, the number of natives employed by members of the Witwatersrand Native Labour Association and contractors was 218,552.

Proceedings and Notices of Societies

INSTITUTION OF ELECTRICAL ENGINEERS.

Examination Results.

The Institution of Electrical Engineers announces the following list of results of the Associate Membership Examination, held last May, with the proviso that success in this examination does not of itself constitute the candidate an Associate Member of the Institution :—

*Whole Examination.**—Abrahams, H. H. (London), Andrews, A. E. D. (Wallington), Arnold, S. R. (Portsmouth), Awcock, J. O. (South Croydon), Barrow, L. L. (Maghull), Bearn, J. (Birmingham), Bonell, A. W. (London), Boyd, W. (Bolton), Brooke, A. J. (Bradford), Cameron, T. T. (Glasgow), Chappell, W. F. (Hessle), Clarke, J. S. (Hull), Clark, W. A. (Hull), Clarke, J. W. (Portsmouth), Clifford, A. E. (Manchester), East, N. (Grimsby), Easton, W. R. (Bolton), Elliott, H. J. (Birmingham), Garbutt, S. (Altrincham), Ginger, I. A. (London), Greer, H. L. (St. Helens), Groom, L. H. (Hull), Halliday, D. (Welling), Handy, W. (Holyhead), Harper, W. G. (Ivybridge), Hickel, M. G. (Rugby), Humphries, L. E. W. (London), Illingworth, J. (Kempston), Kewaisi, M. (Chelmsford), Kidd, W. (Winchester), Lawrence, F. H. (Sutton, Surrey), Linay, E. C. (Worksop), Miller, A. W. (Portsmouth), Mills, E. R. (London), Moores, F. R. (Southsea), Munford, B. A. (London), Nixon, R. J. (Ashton-under-Lyne), Paxton, J. (Aldridge), Pendlington, L. (South Shields), Perera, A. (London), Powell, R. D. F. (London), Reay, C. E. (South Shields), Roberts, G. A. (Worcester), Scudamore, C. J. (Maidstone), Sercombe, D. J. (Torquay), Shroff, S. R. (London), Sowman, A. V. (Manchester), Staygle, E. G. (Worthing), Stringer, J. E. (Southampton), Summerfield, J. K. (Birmingham), Tamkin, R. W. (Portslade-by-Sea), Taunton R. D. (Birmingham), Thornley, E. J. (Southsea), Townend, F. J. (Washington, Co. Durham), Tullis, D. (Glasgow), Tunnicliff, E. (Belvedere), Tyler, J. F. H. (Teddington), Tyrer, A. R. (London), Veevers, J. F. (Northfleet), Walsh, J. J. (Ardnacrusha, Co. Clare), Ward, F. R. (Stoke-on-Trent), Wedgwood, P. (Stockton-on-Tees), Wheeler, G. J. (Hull), Whitfield, J. (Southampton), Wickremesinghe, M. L. (London), Willis, W. R. (Prescot), Young, C. E. M. (Banbury).

* This list also includes candidates who are exempt from, or who have previously passed, a part of the Examination and have now passed in the remaining subjects.

Passed Part I Only. — Carter, J. G. (London), Edwards, J. V. (London), Etherington, H. E. (Higham, Kent), Faithfull, E. W. (Seaton, Devon), Foy, R. L. Southampton), Hunt, J. J. H. (Birmingham), Johnson, E. R. (Hull), Keene, R. N. (London), Lett, F. T. (London), Mead, E. A. (Southampton), Milne, W. H. (Birkenhead), Nottage, W. G. (Bromley), Phillips, A. S. C. (Portsmouth), Reeves, E. (Southampton), Robertson, N. C. (Leigh-on-Sea), Smith, W. E. (London), Spiller, R. F. (Cardiff), Sumner, W. (Forest Hall), Tozer, A. L. (Cranwell), Tydd, G. A. (Glasgow), Wallen, H. (Southampton).

Passed Part II Only.—Coffee, R. (London), Hall, W. G. E. (London), McPherson, A. (Blyth), Whiston, J. (Hinckley).

NICKEL AND CHROMIUM IN GREY CAST IRON.

By Prof. D. Hanson, D.Sc.

The interest that has been taken in improving the quality of cast iron during the past few years is a part of the effort that is being made by engineers and metallurgists to improve the quality of the materials with which they have to deal. Advances may result from work in many different directions, and may include modifications in the casting, working, and heat-treatment processes as well as modifications in composition. The introduction of "alloying" elements into cast iron is one of the directions in which definite advances have been made in the past few years, and in this connection the use of nickel, with or without chromium, has found numerous practical applications.

Iron founders well recognise that in order to obtain consistent results in the foundry it is essential to maintain a proper control both of the composition of the metal and the casting conditions generally. They know that cast iron is very sensitive to variations in some of its constituents, and that a proper balance must be maintained if uniformly successful results are to be achieved. The modern iron founder has therefore made it his business to understand the fundamental actions of the various elements—carbon, silicon, sulphur, phosphorus, and manganese—upon the con-

trol of which the properties of his iron depends. Such a founder will readily appreciate that if other elements, such as nickel and chromium, are to be added to his mixture, they also must be used, not indiscriminately, but with due regard to their characteristic qualities. Thanks to the work of the past few years, the effects of nickel and chromium in grey iron are as well known, both qualitatively and quantitatively, as are the effects of the commonly occurring elements. The expert foundryman can, therefore, on the basis of this knowledge, apply these alloying elements according to principles with which he is already familiar, and thus provide himself with additional resources to meet the exacting requirements of his trade.

In a general way the action of nickel has been known for some time, although it is only within the last few years that it has been worked out with sufficient detail to enable the metal to be used to best advantage. Like silicon and aluminium, nickel is a graphitising agent. It is possible by adding nickel to convert a white iron containing no silicon into a grey iron having the general characteristics of grey cast iron. The graphite flakes produced by the action of nickel are, however, finer than those produced by silicon, with the result that the iron has a closer texture or finer grain.—*The Mond Nickel Bulletin.*

Forthcoming Events.

THE INSTITUTE OF METALS.

The forthcoming Congress of metallurgists to be held in Düsseldorf from September 9-12 promises to be extraordinarily interesting. Already nearly 200 persons from all over Europe — and some from America—have indicated their intention to participate in the gathering.

The congress will comprise (a) the presentation and discussion of about 15 scientific and practical papers relating to metallurgical work; (b) visits to works in or near Düsseldorf and Berlin; (c) Receptions, dances and other social functions.

Persons who desire to participate in the congress should write for particulars without delay to the Secretary of the Institute of Metals, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

20,422.—Cramer, T. M. — Extraction of borax. July 3.

20,191.—Fairweather, D. A. W.—Production of chemical substances. July 1.

20,674.—Faust, O., and Zellstofffabrik Waldof.—Manufacture of bleach liquor. July 5.

20,099.—Ges fur Teerverwertung, and Spilker, A., and Spilker, G.—Purifying naphthalene. July 1.

Specifications Published.

314,555.—British Celanese, Ltd., Green, S. J., and Widdowson, R. A.—Manufacture of aliphatic acid anhydrides.

294,117.—Elektrizitatswerk Lonza.—Manufacture of fertilisers containing nitrogen and phosphoric acid.

314,697.—Manchester Oxide Co., Ltd., and Clayton, R. H.—Purification of crude or impure sulphur.

314,725.—Mond, Dr. A. L. (Rhenania-Kunheim Verein Chemischer Fabriken Akt.-Ges.).—Process of working-up potash salts.

313,036.—Kunstdunger - Patent - Ver - Wertungs-Akt-Ges.—Method of leaching raw phosphate.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

311,885.—Wetting agents. — British Dyestuffs Corporation, Ltd., Hexagon House, Baddiley, J., and Chapman, E., Crumpsall Vale Chemical Works, both in Blackey, Manchester.

Sulphonic Acids. — The method of the parent Specification, according to which wetting or emulsifying agents are obtained from mineral oil fractions by sulphonation and condensation with an alcohol, is modified by conducting the reaction at a temperature of 65° C. or below; the method may

be further modified by using chlorosulphonic acid as the sulphonating agent. The alcohol may be added to the sulphonation mixture or the alcohol and oil may be mixed together and the sulphonating agent then added. In one example, a petroleum fraction obtained by extracting Borneo petroleum with liquid sulphur dioxide is sulphonated with oleum at 60-65° C., and the product is treated with isopropyl alcohol at 60-65° C. after separation of unsulphonated oil and addition of sulphuric acid. In another example, chlorosulphonic acid is added to a mixture of the oil with isopropyl or *n*-butyl alcohol, and the reaction is effected at 20-25° C. or 50-55° C. respectively.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ODORONO.

501,099.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — The Odorono Company, Inc., 114, West 17th Street, City, County and State of New York, United States of America. July 10.

EPHOSIN.

503,494.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes, but not including manures and fertilisers, and not including any goods of a like kind to manures and fertilisers.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. July 10.

SPECIA.

502,891.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — Société Parisienne D'Expansion Chimique, 21, Rue Jean-Goujon, Paris (8e), France. July 10.

PELTORAN.

503,200.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives. — I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. July 10.

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GENERAL INDEX TO THE " CHEMICAL NEWS "—VOLS. 1 TO 100.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—SOUTH AFRICA, 1929.

AFRICA AND SCIENCE.

Address by JAN H. HOFMEYER, M.A., President of the South African Association, on the occasion of the Inaugural Meeting in Cape Town, July 22, 1929.

To-night I enter upon the consummation of what is at once the highest and the least merited distinction which it has been my privilege to receive. To those who called me to the office of President of the South African Association for the Advancement of Science I tender my sincere thanks. I make myself no illusions in respect of the adequacy of my claims to that honour on the ground either of scientific attainment or of services rendered to the cause of Science, nor would I have our visitors remain for a moment without the knowledge that my scientific qualifications for this Presidential Chair are of the slightest. They are far less indeed than those of that distinguished statesman to whom when he had remarked to the great Faraday in relation to an important new discovery in Science, " But after all, what is the use of it? " the scientist replied, " Why, Sir, there is every probability that you will soon be able to tax it." The Presidency of this Association is an honour the conferment of which upon myself has never seemed to fall properly within the scope of my ambitions; it imposes responsibilities for the discharge of which I am all too scantily equipped; and I can only seek to justify my election in a manner similar to that which Mr. Stanley Baldwin followed when he was chosen to be President of the Classical Association in England. I can but say that, while it is to the scientist that we look for the advancement and the progress of Science, the effectiveness with which his work is brought to fruition does depend in some measure on the interest, the sympathy, and the enthusiasm, with which his achievements are followed up by that army of plain, ordinary men, in which I gladly count myself a musket bearer. In no other capacity dare I venture to address you. It was once said by a literary man of some distinction that the man of science appears to be the only man in the world who has something to say, and he is the only man who does not know how to say it. There is an obvious rejoinder, that the man of letters frequently has

nothing to say, but says it at great length. I dare not claim to be a man of science. I can only hope that I shall not be deemed to-night to have qualified for consideration as a man of letters in the sense of that retort.

The honour which has been conferred upon me is the greater because of the special significance which attaches to my year of office. It is the year of the keenly anticipated second visit of the British Association for the Advancement of Science to South Africa, and for that reason my first words to-night are, happily, words of welcome. Not merely the Association for which I speak, but all South Africa, rejoices in the presence of the British Association and its distinguished members. To its parent body, which can look back upon a century of glorious achievement, this stripling Association brings its tribute of respectful admiration and goodwill. To the great organisation of scientific men, the history of which is the history of the advancement of Science in Britain, which has a Presidential Roll adorned by names such as Brewster and Tyndall, Huxley and Kelvin, Rayleigh and Lister, this land of ours, mindful of its debt to Science, conscious of the gifts that Science can yet bring to it, extends the hand of friendship, in gratitude for the honour of this visit, and in appreciation of the stimulus to its progress and development which must needs attend it.

We have reason, indeed, to be grateful to the British Association for its achievement and its significance. If I might select three distinctive features in its record, they would be these. First, its contribution, direct and indirect, to those great triumphs of British Science in the nineteenth century which are the possession not of an age, nor of a nation, but of *all time* and of every land. Directly it has initiated, correlated, and contributed towards work of great scientific value; indirectly it has inspired much constructive activity, while its meetings year after year have done more than any other single factor to stimulate and hasten the onward march of science.

Next I would dwell on its maintenance of a broad view of the scope and function of Science, and, coupled with that, the emphasis laid by it on the essential homogeneity of Science conceived thus broadly, and the interdependence of its several branches. The Association had no lack of opposition to encounter at its coming to birth. Those who interpreted Science primarily in the medieval sense as being limited to the sciences of introspection had still but scant respect for the claims of the sciences of observation. When in the second year of its existence the Association visited Oxford, Keble protested vigorously against the University's reception of what he called a hodge- podge of philosophers. This hodgepodge, be it noted, included Brewster and Dalton and Faraday. But the Association did not react into narrowness. It remained true to the broad conception of *Scientia* which was held by its founders, one of whom affirmed in striking language at the first meeting, that "The chief interpreters of nature have always been those who have grasped the widest fields of inquiry, who have listened with the most universal curiosity on all information, and felt an interest in every question which the one great system of nature represents." The Association has imposed no narrow restrictions on the extension of the sphere of its activity; within that ever-widening sphere it has maintained a spirit of co-operation between workers in diverse fields which has been worthy of the best traditions of Francis Bacon. It has had its reward—in greater effectiveness of work in its own sphere, and in the permeation of the Kingdom of Learning with the atmosphere of goodwill. By way of illustration of this last point, may I, as one whose first allegiance is to the Classics, mention the fact that the roll of twenty-six Presidents of the Classical Association of England includes five Fellows of the Royal Society, names such as Geikie, Osler, and D'Arcy Thomson, and if it is not too presumptuously personal to refer to it, I would add, that when the South African Association elected me as its President, it chose one who was then President of the Classical Association of South Africa.

Lastly, I would select as characteristic of the British Association its success in maintaining the contracts of Science with the public on the one hand and the state on the other. One of the aims which its founders set forth was "to obtain more general attention for the objects of Science"; they sought to create a body which would make its appeal to the educated public as a whole, to fashion an instrument for the interpretation of the sometimes highly technical results of scientific investigation to the man in the street. They realised that the scientist received much from the public, that to the public he must freely give, and that the giving would not be without its due reward of new inspiration and renewed enthusiasms. There were some who opposed the nascent

Association in the fear that Science might degrade itself by making too popular an appeal. That fear has been belied in the passing of the years. The Association has kept touch with the public, at has " demonstrated to all men that Science is thinking with them and for them," it has secured their interest and their sympathy, but it has never paid for that achievement the price of a lowering of its aims or of its standards. It is its success in this respect that has secured for it the prestige which has enabled it time and again to stand forth as the ambassador of Science to the state, and so to play an important part in initiating and furthering enterprises of great national and scientific significance.

For these reasons and for much else South Africa is proud and happy to be able to welcome and do honour to the British Association for the Advancement of Science. We welcome it the more heartily because of our consciousness of the greatness of our indebtedness to the first visit of the Association twenty-four years ago. To that visit, with which there will always be linked a name honoured in the history of South Africa, as it is in the annals of Science—I refer to Sir David Gill—this country still looks back with grateful recollection. It marked the commencement of an epoch in our scientific history, the epoch of the consolidation of the position of Science in South Africa.

Let us view the position of Science in our country as it was in 1905. On the academic side it is the nakedness of the land that chiefly impresses us. South Africa then had but one University, and it was in reality only a Board of Examiners for the candidates presented by various Colleges, which were all, without exception, inadequately staffed and poorly equipped. In the subjects which fell within the scope of the Association, as it was defined in 1905, there were in all the Colleges taken together in that year only forty-nine workers, thirty-three professors, and sixteen others. When it is remembered that this was the total number of teachers of all branches of Science spread over seven different institutions, all purporting to do University work, it is painfully obvious how little time was available for scientific research and investigation. Nor was the work done, measured in terms of the number of graduates, very impressive. The number of those who in 1905 qualified for degrees in Pure and Applied Science was only twenty-seven. Outside of the Colleges scientific workers were to be found mainly in Government Departments, then still small and inadequately staffed, and working in isolation in the four South African Colonies. In most branches the State's scientific activities were still in their earliest infancy. The organisation was only just commencing to be built up. As part of these activities there fall to be mentioned the two astronomical Observatories at that time in operation : the Royal Observatory at Cape Town, then already full of years and of honour, and the Johannesburg Observatory which, thanks largely to the representations made by this Association of ours, had been established a few months before the 1905 meeting. In regard to Scientific Societies there is but little to record. There were in existence in 1905 a small South African Philosophical Society (now known as the Royal Society of South Africa), the Geological Society of South Africa, the Cape Society of Engineers, the Chemical Metallurgical and Mining Society, and also this Association for the Advancement of Science, which had come into existence a bare three years previously. It was, indeed, the day of small things, and small also was the achievement which Science in South Africa at that date had to its credit. If one leaves out of account the work if Sir David Gill and the scientific endeavour which had been put into the development of the gold mining industry of the Witwatersrand, there is little indeed of permanent significance that remains.

Agrainst this picture it is appropriate to set the picture of South African Science as it will unfold itself to our visitors to-day. They will find three vigorous single-College teaching Universities ,which have in recent years made remarkable progress in the attainment of the standards of similar institutions in older hands, and also a federal University with six constituent Colleges, which, like the single-College Universities are, in human and material equipment and in the output of the results of scientific investigation, very far ahead of their predecessors of 1905. Against the forty-nine workers of 1905 we can no wset 429—134 professors and 295 others—within the range at present covered by the activities of this Association. The twenty-seven graduates of 1905 have increased to 275 in 1928. To the Scientific Societies of 1905 there have been added, since the last visit of the British Association, the South African Institute of Electrical Engineers, the South African Chemical Institute, the Botanical Society of South Africa, the South African Biological Society, the Astronomical Society of South Africa, the South African Geographical Society, and

the South African Economic Society, and this Association of ours has become an active, vigorous, and powerful body, proud of the achievements which it already has to its credit, challenging eagerly the tasks that await it in the future. The two Observatories of 1905, our visitors will find, have increased to six, including the Smithsonian Solar Observatory in South-West Africa, and the equipment of these institutions includes four great telescopes, with objectives of 27 inches, 26½ inches, 26 inches, and 24 inches respectively, to which will shortly be added a 24-inch refractor and a 60-inch reflecting telescope — surely a remarkable astronomical equipment for so young a country. The stimulus of the 1905 visit, in which so many prominent European astronomers participated, has indeed borne rich fruit in the advancement of astronomical work in South Africa.

But perhaps our visitors will be impressed not least by the development and consolidation of the scientific departments of our Civil Service, by the magnificent Institute of Veterinary Research which the state has created at Onderstepoort and the effective work which through its scientific officers it is doing for the development of South Africa, and by the remarkably efficient and well-equipped Institute for Medical Research at Johannesburg, the credit of the establishment and maintenance of which falls jointly to the Government and the Mining Industry. Significant also of the attitude of the state to Science, and full of promise for the future, has been the establishment of a Research Grant Board, which advises the Government on the practical measures necessary for the encouragement of scientific research in the Union, and acts as its agent in the distribution of grants in aid of individual investigations.

Nor have we reason to be ashamed of the positive achievements of Science in South Africa during the past quarter of a century. Most impressive, perhaps, regarded cumulatively, have been the advances made in our knowledge of the diseases of plants, animals, and men, and of the methods of preventing them. In 1905 we knew practically nothing of the plant diseases of South Africa. In that year the first steps were taken towards their scientific investigation. To-day a general survey has been completed, most of the important diseases have been worked out, and a highly efficient service for combating them is in operation. In 1905 also the Transvaal Crown Colony Government voted £1,500 as a first instalment towards the establishment of a laboratory for the investigation of stock diseases. From that has sprung the magnificent body of work in veterinary science, which has won world-wide recognition for the Onderstepoort Institution which I mentioned a moment ago. More recently there has been founded the South African Institute for Medical Research, to which is allied the Miners' Phthisis Medical Bureau. The researches conducted there in the control of pneumonic infection, and the advances made in industrial hygiene in the fight against silicosis, have brought great lustre to these two institutions and to South Africa. But in other fields also South African scientific workers have won recognition. In Geology, Marine Biology, the Mathematical Theory of Determinants, the Economics of Gold Production, and along several other lines of investigation, important scientific work has been done in South Africa; a succession of discoveries has been made throwing light on the origins of the human race; and applied science has by means of the conquest of distance in this far-flung land of ours, and of the construction of important irrigation and other engineering works, contributed generously to South Africa's progress. It may, perhaps, be taken as a measure of the achievement of Science in South Africa in one of its aspects that, while in 1906 the value of products of the land exported from South Africa amounted to £5,928,000 the corresponding figure for 1927 was £27,815,000.

But if I were asked to select the most broadly significant feature in the development of Science in South Africa since 1905, I think I would pick out what one might describe as its South Africanisation. In 1905 Science in South Africa was in large measure exotic. The workers had come almost exclusively from other lands. They were only beginning to apply themselves to our South African problems. In many cases they had not yet acquired a South African background, nor a South African outlook. In the years that have passed South Africa has claimed those workers for her own, and they have given themselves to her service. They to whom this is the land of their adoption, no less than those to whom they have taught and inspired, have made it the land of their vigorous and devoted service. In its personnel Science in South Africa has become essentially South African. And Science has given itself with enthusiasm to the problems of South Africa. It has emphasised the specific contributions

of South Africa to the wider problems of Science, it has applied itself to the removal of those obstacles which hamper the material development of South Africa, it has taken up vigorously the study of South African Economics and Sociology and Anthropology. Perhaps also one may claim that it has brought to bear on scientific investigation what we regard as the distinctive features of the South African outlook—freshness and breadth of view, receptivity to new illuminations, and readiness to see old truths in new settings and in the light of their wider bearings. Is it not South Africa that has given to Science and the world the conception of *Holism*? And there is surely no gift more worthily representative of the South African outlook at its best that we could have offered. It may indeed be that that very South Africanisation of our South African Science of which I have been speaking is but another instance of the Holistic principle at work. As I speak of the South African outlook in Science, I cannot but refer you with that deep appreciation which I know we all feel, to the masterly address which four years ago General Smuts delivered from this chair, when he demonstrated in so compelling a manner (I quote his own description of the task he set himself) "that there is something valuable and fruitful for Science in the South African point of view, that our particular angle of vision supplies a real vantage point of attack on some of the great problems of Science; and that, so far from the South African view-point being parochial in Science, it may prove helpful and fruitful in many ways to workers in the fields of scientific research and investigation."

ABSTRACTS FROM THE PROCEEDINGS OF THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Chemical Inventions.

It is felt that chemical inventions have not, in the past, received the attention they deserved. Particular attention has been directed to section 38 (a) of the Patents and Designs Acts, 1907 and 1919, which is said to be so ambiguous that considerable and unnecessary expense has been incurred by applicants for patents. This section deals with chemical processes, and with chemical products and substances intended for food or medicine, and it has been suggested that it should be divided into two parts—the first to deal with inventions relating to substances prepared or produced by chemical processes, and the second relating to substances intended for food or medicine. In an amending Act, the first should be made clear; and the second might provide that patents will not be granted for mere prescriptions, formulas or recipes for foods or medicines, or that patents will not be granted for any inventions relating to substances intended for food or medicine.

The matter has been referred to the Legal and Parliamentary Committee of the Institute.

Problems of Vitamin Research.

(Birmingham and Midlands Centre.)

In a lecture, Prof. J. C. Drummond dealt with the early work of Hopkins, leading to the recognition of the existence of accessory food factors, and then considered the claims that had been advanced by various workers in respect of the isolation of specific members of the group known as vitamins. The difficulties involved in this work of isolation, which did not tend to decrease with the passage of time, were exemplified by reference to the case of the supposed vitamin isolated by Funk in 1914. Recent methods were described in detail, and, following the work of Windaus and others, the chain of events leading to the recognition of ergosterol as the parent substance of vitamin D was then discussed.

Heat Transmission.

(Edinburgh Centre.)

Mr. J. Arthur Reavell dealt with the subject in three sections: heat transmission from steam to a liquid, as ordinarily happened in heaters and evaporators; heat transfer from liquid to liquid, of which practical examples were to be found in heat exchangers and heaters using oil as the heating medium; and heat transfer from air and other gases.

Mr. Reavell indicated the various factors involved in calculating the required surface of a heater and hence its heat transfer coefficient. He showed that by basing the design of a heater on the scientific application of the laws of heat transfer, it was possible to reduce its surface, and thus secure economy. For example, by designing an evaporator so that the incoming feed was heated by a special heater, and also in the case of a single effect evaporator, by arranging to utilise the vapour evaporated, distinct economies could be secured.

The amount of heat transmitted by a heater did not depend on the metal of which it was made, mild steel functioning quite as well as copper, which had a much greater heat conductivity. It depended, however,

to a very large extent on the resistance of the liquor film to heat flow. This in turn was influenced by the viscosity and heat conductivity of the liquor, and the size of the evaporator tubes.

The heating of linseed oil for the manufacture of varnish provided very interesting data as to the advantage of heating by means of hot oil, relative to direct gas firing. Taking average costs for oil and gas, and otherwise normal conditions, it was found that for a cost of one penny, 10 gallons of linseed oil could be treated, using hot oil, as against 2 gallons using gas firing. A combination of oil and electric heating had recently shown an efficiency of 98 per cent.

THE CHEMIST IN THE PETROLEUM INDUSTRY.

(*London and South-East Counties.*)

In a lecture Dr. A. E. Dunstan surveyed the field of activity of the petroleum chemist and, with the aid of a series of lantern slides, demonstrated the important part taken by chemists throughout the petroleum industry, indicating at the same time the effect of research work in the enormous development of petroleum technology during the last few years.

Starting with the oil fields he outlined modern geophysical methods used in the search for oil, and the part played by the chemist on the oil field in connection with geological work, in the separation of oil and gas, and the elimination of sulphuretted hydrogen. Then followed the research chemists' work for the utilisation of the gas by stripping and thermal decomposition for the production of liquid aromatic hydrocarbons of use as "anti-pinking" motor fuel.

He emphasised the necessity for developing the natural inclination or ability of petroleum chemists, whom he divided into three main groups — analytical chemists, development chemists, and research chemists. The first class was employed for analysis and routine work, the second dealt with the conversion of processes from the laboratory stage into commercial scale units, whilst the third class was composed of men with ideas or inventive capacity, to produce new processes on the laboratory scale.

The second part of the lecture dealt with refining operations, distillation, chemical refining and cracking, with particular mention of the modern pipe still, the hypochlorite of lime treatment for removal of sulphur compounds in petrol and kerosene, the bauxite filtration process for decolorisation of kerosene, and the liquid sulphur dioxide extraction progess which, by the removal of aromatic compounds, yields non-smoking kerosene, the utilisation of the extract after recovery of the sulphur dioxide, and removal of amorphous wax from lubricating oil stock.

As examples of cracking processes, the high pressure work of Bergius and the Cross and Dubbs plants were briefly described.

QUALITATIVE ANALYSIS OF INORGANIC SUBSTANCES AND ITS PLACE IN A SCHEME OF INSTRUCTION IN CHEMISTRY.

(*South Wales Centre.*)

Mr. E. A. Tyler expressed the opinion that qualitative analysis too frequently occupied a very subordinate position in a course of instruction. Substances were given out for analysis and, so long as the end was obtained by naming the constituents, little attention was paid to the means employed to attain that end. Often the student was left to his own resources and was compelled to look for guidance from a text book which was a mere collection of well-known tests and tables. In such circumstances the student, by applying inductive methods based on a preconceived idea, succeeded in deceiving himself that he had obtained results which confirmed that idea. Such so-called qualitative analysis was harmful, and led to the not uncommon habit of "faking" results. Qualitative analysis could, and should, occupy a more worthy position, and it was suggested that seldom was a school the proper place to attempt systematic qualitative analysis. At school a boy should acquire habits of observation by carefully noting the action of heat and of common acids on small quantities of substances, identifying any gases evolved. He should learn to make the best use of a Bunsen flame and should also make use of the blowpipe.

Simple volumetric and gravimetric exercises would follow, until the student reached a state of knowledge enabling him to proceed to mass action and the ionic theory as applied to the study of the composition of inorganic substances. With the addition of some knowledge of colloids, qualitative analysis would become a scientific study—not merely an art. Observations would be truly recorded, and the deductive method would become a habit.

Mr. Tyler drew attention to the advice given in the introduction to Fresenius' Qualitative Analysis, and also gave examples of very persistent and common errors,

e.g., the belief amongst students that the oxalate test is "specific" for calcium. He also wished to know why so many text-books persisted in the exclusive use of *potassium* hydroxide. Finally, Mr. Tyler called attention to the work of Noyes and his colleagues, and also to various useful books.

FURTHER PROGRESS IN CRYSTAL ANALYSIS.

By Sir William Bragg, K.B.E., D.Sc., F.R.S., M.R.I., Fullerian Professor of Chemistry.

(A Lecture given before the Royal Institution, on January 18, 1929, Sir Robert Robertson, K.B.E., D.Sc., LL.D., F.R.S., Secretary and Vice-President in the chair.)

Alloys have played a great part in the history of mankind. The qualities of pure metals are rarely desirable, but the properties of alloys cover a far wider range, within which can be found every variety of usefulness. Pure copper is too soft for most purposes, but when varying quantities of tin are introduced the bronzes so formed have many applications. At one stage of human development bronze was all-important. It is still largely used. The copper coinage is only slightly alloyed; the useful "gun-metal" contains a larger quantity of tin, bell-metal contains more, and speculum or mirror-metal more still. Small quantities of other substances, especially zinc, are often inserted into bronzes; and the influence of minute quantities of such foreign substances is remarkable. Since many substances can be used in making alloys, two or more at a time, and since even minute quantities of a component often change the properties entirely, it will readily be understood that the possible variations are almost infinite. Among these metallurgists seek for those which can be put to practical use. Great advances have been made in recent years, and such terms as chrome steel, manganese steel, duralumin and the like, have become common.

The reasons for this variety are most obscure, and great interest attaches to any method which can help to bring order and understanding into the complexity. The X-rays have come to give assistance of a novel kind. They reveal the modes in which the atoms are arranged in solid substances, provided that any regularity of arrangement exists, and in general this is the case. It turns out that the atoms in the different phases of a mixture are put together according to different patterns, and the properties of the substances are obviously connected with the pattern. In pure copper the atoms are piled together in close packing, like spherical shot; each sphere then touches twelve neighbours. When a small number of zinc atoms are added they distribute themselves at random amongst the copper atoms without disarranging the pattern very much. But there is a limit to this addition. If too much zinc is put in a new pattern is formed, in which each atom now has only eight neighbours. Next comes a remarkable change as more zinc still is put with the copper. A very complicated pattern is formed of which the unit is twenty-seven times as large as in the preceding case, and there are fifty-two atoms in it. This alloy is very hard and brittle. Curiously enough there is an alloy of copper with aluminium, and again of copper with tin, in which the same properties are exhibited, the same pattern is found, and the same number of atoms in the pattern. Moreover, what is still more interesting is that there is the same number of free electrons. The free electrons are those which a metal can shed comparatively easily; a zinc atom can shed two, an aluminium atom three, and a tin atom four. These curious alloys are composed of five atoms of copper to eight of zinc, nine of copper to four of aluminium, and the third, very approximately, in the ratio of thirty-one of copper to eight of tin. In each case there are thirteen atoms to twenty-one electrons.

These new results, which are most interesting from all points of view, are due mainly to the work of Owen and Preston, Bradley, and Bernal in England, Westgren and Phragmen in Sweden. They open up new ideas of the conditions in the alloy. They suggest that we ought not merely to think of an alloy as a mixture of atoms, but in some cases at least as a mixture of electrons with atoms, the latter having considerable latitude as to nature.

Somewhat similar conclusions have been reached in regard to the silicates composing by far the major part of the earth's crust. We are getting away from the conception that the "molecule" of liquids and gases is generally to be found in all solids.

In a different direction an important step forward has been made in Mrs. Lonsdale's (Miss Yardley) determination of the disposition of the atoms in the organic compound hexamethyl benzene. The application of the X-ray methods to organic structures has always been very tempting, because the properties of the organic molecule depend so remarkably on the mutual arrangement of the atoms of which it is

composed. This has of course been long known, and it has been found possible to arrive at some knowledge of the particular designs by studies of the chemical reactions peculiar to them. But the X-rays may be expected in the end to furnish quantitative, as against qualitative, details of the molecular structure, and to give the relative positions of the atoms in space. The long chain compounds, which constitute a very important section of the organic substances, have already been attacked with sucess, but the other important section, consisting of substances founded on the benzene ring, have not hitherto proved so amenable. They are more complicated, and their analysis is more difficult. If any one of them can be worked out in detail the whole problem will be simplified. It appears that Mrs. Lonsdale's solution in the case of hexamethyl benzene has actually provided this initial success. The molecule consists of the hexagonal benzene ring of carbon atoms, to each of which is attached a methyl group (CH_3). The unit of pattern contains only one molecule. It is triclinic, that is to say, there are no planes or axes of symmetry; there is, however, a centre of symmetry. As there is only one molecule in the unit cell, this centre is found in the molecule itself, the only symmetry which is possesses. In certain ways the cell very nearly possesses other symmetries, and by a skilful use of these approximations as measured by the curious effect which they have on the relative intensities of reflection by different sets of planes within the crystal, Mrs. Lonsdale has been able to place every carbon atom in the molecule. The result gives a picture of the molecule resembling even more closely than is usual in these cases the diagram of the chemist, except of course that the symmetry is not quite so perfect as the diagram shows. All the carbon atoms are in one plane. It is now to be expected that the way is made easier for attempts to solve the structures of other organic substances of the same important group.

BRITISH ASSOCIATION MEETING AT CAPE TOWN.

The Presidential Address to Section B (Chemistry) was delivered on July 23 by Prof. George Barger, F.R.S., whose subject was "The Relation of Organic Chemistry to Biology." An account of the Address will appear shortly in *The Chemical News*.

RAYON.

Fabrics made from Rayon, or "artificial silk," as it was formerly termed, arouse immediate admiration and their popularity may be estimated by the ever-increasing output of rayon annually; 300,000,000 lbs. were made last year. The production of rayon has been brought about as the culminating stage in a long series of researches with the object of forming a fabric which would have all the good attributes of silk materials and yet be within the reach of all.

The success of a number of interesting processes has led to the publication of a number of monographs on the Rayon Industry and not the least important of these is the latest to appear [*Artificial Silk (Rayon), Its Manufacture and Uses.* By THOMAS WOODHOUSE, F.T.I. Pp. x + 245. Second, revised and enlarged edition. London: Sir Isaac Pitman & Sons. 1929. Price 7s. 6d.] This book contains an excellent description of the progress made in the manufacture and uses of Rayon during the past year. The latest technical developments are fully explained and a feature of the volume is the number and variety of the illustrations.

Probably the first suggestion for making "artificial silk" came from Réaumur who, in a work on Natural History (1834-42) pointed out that silk was a liquid gum which had been dried; could we not make silk ourselves with gums and resins? This idea, which would appear fanciful at first sight, is more promising on closer examination. About a hundred years later, Audemars at Lausanne, attempted to make a continuous thread in imitation of silk from a cellulose solution. Its possibilities for electrical purposes attracted the attention of a number of scientists including Swinburne, Sir Willliam Crookes, Weston, Swan and others. The first successful and extended experiments were conducted by H. de Chardonnet whose name is still associated with Rayon made from cellulose nitrates.

Mercer's experiments on the action of alkalis on cotton, whilst not actually producing artificial silk, paved the way for the production of kinds other than the artificial silks from the inflammable cellulose nitrates. Co-operation of the engineers became essential to further progress in devising machinery for filtering and forcing the cellulose solutions through fine orifices to produce threads for weaving.

Other processes for the production of artificial silk were sought because of the inflammable nature, not only of the product

(which can be re-converted into cellulose by ammonium sulphide, etc), but also of the alcohol-ether solvent. Schweitzer discovered that cellulose dissolved in ammoniacal copper oxide solutions and from this he obtained threads which could be woven satisfactorily. By far the most important process, however, is that due to Cross, Bevan and Beadle, who discovered that cellulose treated with a 17-18 per cent. solution of sodium hydroxide (like Mercer's solution) reacted with carbon bisulphide to form a viscous soluble derivative, sodium cellulose xanthate, to which the name Viscose was given. More recently the cellulose acetates have been used for Rayon, the chief concern manufacturing this type being British Celanese, Ltd.

It will be seen that the raw material for Rayon is cellulose, which should be cotton linters or purified wood pulp. It can be (1) nitrated as in the Chardonnet process, (2) acetylated as in the " Celanese " process, (3) dissolved in cuprammonium solutions (Despeissis or Pauly) (4) made into viscose (Messrs. Courtauld's).

The mechanical problems involved in securing even threads and in weaving have now been successfully overcome and the whole industry is another example of the advantages accruing to mankind by the cooperation of engineer and chemist.

The book under review, by Mr. Woodhouse, whilst containing one or two minor and unimportant slips, is undoubtedly an authoritative treatise upon the subject and should appeal to both the chemist and the non-technical reader.

J. G. F. Druce.

GENERAL NOTES.

TRADE ABROAD.

His Majesty's Consul at Leipzig has informed the Department of Overseas Trade *that according to the Chemnitzer Tageblatt* the backward tendency in the import of raw tobacco through the German customs already evidenced last month has further increased in quite an extraordinary degree. While in the first four months of 1928 718,000 hundredweights, worth 89½ million marks, were imported into Germany, in the corresponding period of the present year only 638,000 hundredweights, valued at 72½ million marks, were introduced from abroad; this means a decrease in tobacco import for the first four months of this year of not less than 80,000 hundredweights and 17 million marks less sent abroad. The diminution in the import of cigar tobacco is particularly striking, its percentage being almost twice as great as that of cigarette tobacco. The following table gives in hundredweights the main imports for the first four months of 1929 and 1928 respectively :—

	1929	1928
Dutch East Indies ...	208,500	246,500
Greece	114,700	119,600
Turkey	69,200	56,700
U.S.A.	64,800	62,000
Brazil	58,100	71,800
Bulgaria	50,200	56,000
Dominica	40,000	68,000
Russia	8,800	1,700
Cuba	6,800	11,000
China	5,000	7,150
Columbia	8,900	6,400
Algeria	1,800	1,300
Hungary	1,700	1,200
Holland	1,600	1,700
Haiti	1,400	8,400
Paraguay	1,200	1,250
Mexico	1,000	1,000

Canada, British India and the Philippines *also exported small quantities of tobacco to* Germany. The largest decrease in this export compared with the previous year was from Haiti and Cuba. Cuban tobacco has become too expensive for Germans. Germany took less tobacco also from Brazil, the Dutch Indies, Columbia, Greece and the Dominican Republic. The import of Turkish tobacco, which is used almost exclusively for the manufacture of cigarettes, was considerably greater and also the import of Russian tobacco which finds a large market in Germany more on account of its cheap*ness than its quality.* German export of tobacco was during the period under review only 1,500 hundredweights, for which 108,000 marks were paid.

The import of manufactured cigarettes and cigars was limited; nevertheless it *reached in cigarettes a total weight of 176* hundredweights, worth 168,000 morks, as against 160 hundredweights in the corresponding period of the previous year. The import of manufactured cigars diminished from 110 hundredweights in 1928 to 104 hundredweights in 1929. Particularly striking is the decrease in Germany's export of cigars, from 2,800 cwt. in 1928 to 1,750 cwt. in 1929. During the same period 1,380 cwt. of cigarettes, value 436,000 marks, were exported as compared with 1,400 cwt. in the year before. The cigarette export has consequently remained practically unchanged. Germany purchased

2,200 cwt. of cigarette paper, value 299,000 marks, during the first four months of 1929 as against only 2,050 cwt. in the corresponding period of 1928. Most of this paper came from Czechoslovakia and France and a smaller quantity from Austria.

SODIUM ACETATE (COMMERCIAL) FOR AUSTRALIA.

His Majesty's Trade Commissioner at Melbourne (Mr. H. L. Setchell) reports that the Victorian Railways Commissioners are calling for tenders, to be presented in Melbourne by the 2 October, 1929, for the supply of 25 tons of sodium acetate (commercial). (Contract No. 42729.)

Firms desirous of offering sodium acetate of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 5484 should be quoted.

At the International Aero Exhibition, Olympia, July 16 to 27, Nobel Chemical Industries, Limited, have their stand on the ground floor of the Main Hall.

The Company display products of Nobel Chemical Finishes, Limited, as applied to aircraft manufacture, including clear oil varnishes, stoving enamels, crystallising enamels, dope-resisting paints, air drying pigmented varnishes, glossy stoving enamel, grey-green anti-glare oil paint for cockpits, different types of undercoats and also aeroplane dope and other similar products.

There is on view parts of an aeroplane treated with the Company's various finishes, and one exhibit shows the Doping Scheme which has been used on the new airship R.100.

Representatives of the Company attend at the stand to give all information and answer all enquiries.

DEATHS BY GAS POISONING.

The President of the Board of Trade has appointed a Committee to consider the increase during recent years in the number of deaths ascribed to poisoning by coal gas supplied for domestic purposes, and to make recommendations as to any measures relating to the production and use of gas for domestic purposes which might be taken with a view to diminishing the number of such deaths.

The Committee consists of the Right Hon. Sir Evelyn Cecil, G.B.E. (Chairman), Sir John Robertson, C.M.G., O.B.E., M.D., Professor R. V. Wheeler, D.Sc., F.I.C., and Mr. F. J. Wrottesley, K.C.; with Mr. H. L. Spencer, of the Board of Trade, as Secretary.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

BOARD OF TRADE ANNOUNCEMENT.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during June, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 625, of which 509 were from merchants or importers. To these should be added 8 cases outstanding on the 31 May, making a total for the month of 633. These were dealt with as follows :—

Granted—581 (of which 555 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—32 (of which 25 were dealt with within 7 days of receipt).

Outstanding on 29 June—20.

Of the total of 633 applications received, 580 or 92 per cent. were dealt with within 7 days of receipt.

CANADIAN MINING NOTES.

According to the Manitoba *Mining News Letter* issued on June 21 last by the Industrial Development Board at Winnipeg, 900 men are now employed either at the Flin Flon mine itself or at the power site at Island Falls, and satisfaction is felt by the Company at the progress now being made. Power from the temporary plant at Island Falls is now in use at the mine, 1,500 h.p. being available.

A number of the mine buildings are now nearing completion and excavation for the main plant is progressing. The zinc tank room and zinc casting room excavations are finished, and are now ready for the concrete work. Work has started on the zinc leaching plant and on the concentrator.

At the Sherritt-Gordon Mines, the Company's engineers are engaged on the designs for the initial concentrator unit with a capacity of 1,500 tons daily, and work is progressing steadily on the railway line which will connect the mine with the Flin Flon Branch of the Hudson Bay Railway.

At the annual meeting of the Mandy Mines, Ltd., held recently in Philadelphia,

the President of the Company stated that he had received a despatch to the effect that the drillers had cut into four feet of copper-zinc ore. General satisfaction was expressed in respect of the work done to date at the mine.

Bullion recovery from the Central Manitoba Mines during the period April 1 to May 15 is announced as $71,00, the largest consignment yet set out from the property. An extensive exploration campaign has been outlined for the Kitchener property.

The News Letter also contains data relative to progress at the property o fthe Shatford Basin Mining Company, the Oiseau River Mining Syndicate, and Jack Nutt Mines, Limited. At the latter property samples of ore are stated to have yielded encouraging values in tin and zinc.

COAST SMELTER FOR BRITISH COLUMBIA.

The British Columbia Government is stated to have been informed that the Consolidated Mining and Smelting Company of Canada, Ltd., intends to erect a smelter in the neighbourhood of the Lois (or Eagle) River. On this assumption, the Provincial Government has passed an Order-in-Council prescribing a reserved area within a circle thirty miles in diameter, with its centre near Thunder Bay, three miles south-east of the mouth of the Lois River, in which area the Company will be able to choose a site for the suggested smelter.

The Company has requested that pending a decision on the water powers, protection should be given from speculators and others who might take up land near the River in anticipation of smelter development. The Government has established a reserve large enough to provide an adequate fume area. It is pointed out that the proposed copper smelter could be located at any point near the centre, and its fumes would not cause damage outside the reserve, most of which is composed of logged-off lands.

An application for the use of the Lois River water powers has also been received from the Powell River Company, which wishes to erect a new pulp and paper mill in the neighbourhood. The Government has therefore to decide to which of these Companies the necessary licence shall be issued.

NEW LARGE COKE PLANT FOR ONTARIO.

The Dominion Gas Company of Hamilton, Ontario, a subsidiary of Cities Service and the Henry L. Doherty interests of New York, intend to erect at Port Stanley, Ontario, a coking plant, the cost of which is estimated at $3,000,000.

IRON AND STEEL FOUNDRIES.

Important extensions to the plant of the Hull Iron and Steel Foundries, Limited, have been announced by Mr. A. H. Coplan, president and managing director of the Company, who states that the improvements contemplated involve the expenditure of $200,000.

Included in the expansion programme of the company which does a large export trade with chromite steel and steam railway equipment to the United States is the erection of a four-storey addition to the main building, to be built of reinforced concrete and brick. It is also proposed to build a brick and reinforced steel recreation building two storeys high for the use of the employees.

The extension to the main plant will be used for the manufacture of steel side frames and steel bolsters for freight and passenger steam railways and cars, according to standards established in Canada and the United States.

The entire system of heat-treating steel ovens for producing high-grade alloy steel, formerly heated by coke will be electrified, which will mean the acquisition of an additional 3,000 h.p., which will be obtained from the Gatineau Power Company. The ovens will be automatically controlled to the required temperatures.

It is stated also that installation will be made of the latest power moulding machines, and the output of chromite heat-resisting steeel used in the manufacture of locomotive grate bars on Canadian and American railways will be doubled.

INCREASED COAL PRODUCTION.

According to the Quarterly Coal and Coke Statistics for Canada, issued by the Dominion Bureau of Statistics at Ottawa, Canada's coal production was 2 per cent. higher in the first quarter of 1929 than in the corresponding period of 1928, while imports into the Dominion of coal were 7 per cent. greater. The coke statement indicates an increased production of 22 per cent. over the corresponding period a year ago, and 28 per cent. over the first quarter of 1927. The tonnage of coke charged to iron blast furnaces was 24 per cent. above the total for the first three months of 1928.

The output of coal from Canadian mines

in January, February and March this year amounted to 4,613,739 tons, the comparative figure for the first quarter of 1928 being 4,508,297 tons. Imports during the quarter were 3,343,830 tons, comprising 3,282,895 tons from the United States; 51,184 tons from Great Britain; 9,716 tons from Russia; and 35 tons from Newfoundland, as against 3,112,224 tons, of which 3,094,271 tons were from the United States and 17,958 tons from Great Britain during the first quarter of 1928.

Details of the importations show a total for anthracite 133,557 tons greater than in the first quarter of 1928, the figure for January, February and March of this year being 861,724 tons. Imports of bituminous coal were 96,585 tons greater, the total for the quarter being 2,476,421 tons.

Exports of Canadian coal were also slightly greater at 240,113 tons compared with 224,884 tons in the first quarter of 1928.

That the manufacture of coke is a rapidly growing industry in Canada due to increased sales and larger smelter requirements is evident from the figures for the quarter. Production in Canada during the three months ended March 31, 1929, totalled 650,617 tons as compared with 538,671 reported for the first quarter of 1928 and 506,587 tons produced during the corresponding period of 1927.

The makers of coke reported sales during the first quarter of this year of 316,713 tons compared with 238,497 tons a year ago and consumption in associated smelters rose to 303,515 tons from 263,668 tons. Tonnage used in coke plants also rose to 67,398 tons from 60,088 tons.

Charges to coke ovens during the first quarter of 1929 included 65,771 tons of imported bituminous coal out of a total of 894,175 tons, Canadian mines supplying the balance of 237,404 tons. Canada also imported in the period under review 327,764 tons of coke which with the Canadian production of 650,617 tons made an available supply of 978,381 tons; allowing for 7,172 tons exported, apparent consumption amounted to 971,209 tons. This figure compares with the apparent consumption of 760,234 tons in the first quarter of 1928 showing an increase in Canada's coke requirements this year of nearly 28 per cent. Coke charged to iron blast furnaces during the three months ending March 31, 1929, totalled 290,087 tons as against 234,118 tons charged in the first quarter of 1928, an advance for this year of 24 per cent.

NOTICES OF BOOKS.

An Introduction to the Chemistry of Plant Products. Vol. II. Metabolic Processes. By Paul Haas, D.Sc., Ph.D., and Prof T. G. Hill. *Second Edition.* Pp. viii + 220. London: Longmans, Green & Co. 1929. Price 10s. 6d.

The Chemistry and Physiology of Plant Life is claiming more and more attention and is obviously a field where there is much to be investigated by the biochemist. The important work by Profs. Haas and Hill first appeared in 1922 and it is noteworthy that a second edition of their work has appeared within a relatively short interval.

In Vol. II. the authors deal with the metabolic processes taking place within the living plant. The syntheses of carbohydrates, fats and proteins are described in detail and there is a lengthy chapter on respiration and its mechanism. The main results of all these processes are growth and reproduction. The concluding chapter on growth is largely concerned with the conditioning factors and it is here in particular that the text has been considerably extended.

Organic chemists, biochemists and biologists will find this and its companion volume indispensable.

PAPER MAKERS' DIRECTORY.

It will be welcome news to those interested in the Paper and Allied Trades that the 1929 edition of the *Paper Makers' Directory of All Nations*—its 38th annual issue—is just published (cloth bound, pp. 1,080, price 21s. net), by Dean and Sons, 29, King Street, London, W.C.2.

This Red Book of the Paper Industry gives detailed particulars regarding the paper, pulp and board mills of the world, such as location, productions, number and width of machines, tonnage output, power used, telegraphic address, etc., as well as lists of British wholesale stationers, paper merchants, waste paper merchants, rag merchants and paper stock dealers, china clay producers and merchants, cardboard box manufacturers, paper bag makers, and paper agents with the mills they represent; the mill productions, too, are classified under 400 trade headings, alphabetically arranged as to products, country and mill.

The classified index to commercial prospectuses (pages xiii to xxxvii) forms an international buyers' guide of special interest and value to those connected with the paper trade both at home and abroad.

SORPTION OF GASES BY POROUS MATTER.

By Jitsusaburo Sameshima.

Sorption of gases by porous matters such as charcoal, silica gel, etc., are generally considered to be one of adsorption phenomena. Thus the molecules of the gas condense on the surface of charcoal. Some authors consider that the gas molecules condense to liquid in the capillary. But it is highly improbable that, except the easily condensable vapours, the gas liquefies at a temperature so far apart from its normal boiling point. McBain considered that a small part of the gas diffuse into the mass of charcoal while the most part are adsorbed on the surface of the charcoal, and he used the term "sorption" for such a case. (McBain, *Z. physik. Chem.*, 1909 LXVIII, 471.)

The author has measured the sorption by various kinds of charcoals of air (Sameshima and Hayashi, *Science Reports of the Tohoku Imperial University*, 1924, XII, 289), and of carbon dioxide as well as the sorption velocity by sugar charcoal of carbon dioxide. It was known that the sorption velocity of gas by granular charcoal is smaller than that of a powdery one, while the sorption amounts by both charcoals are quite the same. We saw, moreover, that the amounts of sorptions o fcarbon dioxide by various kinds of charcoals are not so different from each other notwithstanding the divergence of the materials from which the charcoals were made. According to the results of these observations, the author concluded that the sorption of gas by charcoal is to be ascribed to the dissolution and not to the adsorption.

By the experiments on the sorption of gases by chabazite, it can naturally be supposed that the gas molecules enter into the crystal of the dehydrated chabazite in the places where the water molecules were formerly situated. There are vacant cavities in the hedydrated chabazite crystal, each of which was formerly filled with a water molecule. If such dehydrated chabazite is brought in contact with a gas, the gas molecules enter into the mass of the crystal and take possession of the cavities which were left unoccupied. Thus the crystal is still a homogeneous phase in the sense used in the phase rule.

The author considers that the same can be said in th case of charcoal and silica gel. Charcoal has a great number of molecular cavities which were left when it was produced by the decomposition of carbohydrate, etc. Silica gel has also molecular cavities left by the departure of water molecules in the process of dehydration.

Now the gas molecules dash into one of these molecular cavities and are attracted and captured by the surrounding charcoal atoms or silica molecules. The gas molecule settles into the molecular cavity and makes a homogeneous solid solution. So the sorption process is not quite the same with the ordinary dissolution process, while the product is a solid solution. The phenomena can neither be termed "absorption" nor "adsorption." We will use the term "sorption" for this case, having the different meaning from that used by McBain. Our "sorption" means the entering of the gas molecule into the molecular cavities and forming a solid solution.

It is a well known fact that the more easily condensable gases are absorbed the more, and this is considered to be one of the reasons for the adsorption hypothesis. This relation, however, never strictly holds, but only approximately. According to the author's theory, the easily condensable gas molecule is liable to be captured more easily than the non-condensable gas molecule. In other words, the more active gas molecule is the more difficult to be prisoned. In the process of the ordinary dissolution, the solute molecule push aside the solvent molecule. So the molecular affinity between soluts and solvent molecules is the most important factor for the ordinary dissolution.

Some authors ascribe the rapidity of sorption of gases by the porous matter as due to the surface adsorption. They say that if it be a diffusion phenomena, then the sorption will proceed more slowly. This statement is correct, however, only in the case of the diffusion into a compact solid body. In a case of the porous body such as charcoal, the contact surface between gas and solid is very large, and therefore, the "diffusion" goes on very rapidly. By powdering the charcoal, the surface area will increase so the sorption velocity will also increase. This was already proved experimentally.

Another reason of the adsorption hypothesis consists in the non-expansion of the adsorbent body. The expansions of charcoals by the sorptions of carbon dioxide and water vapour were observed recently by Meehan (*Proc. Roy. Soc.*, A, 1927, cxv, 199) and Bangham and Fakhoury (*Nature*, 1928, cxxII, 681). The amounts of expansion of charcoals determined by these authors are rather small, i.e., in the order of 0.1 per

cent. This can be explained by the present author's theory that the CO_2 molecules enter into the cavities of charcoal.

It is known that the sorption isotherm generally deviates from the Henry's law. This can easily be understood from the difference between the author's theory and the ordinary dissolution process. In the case of the sorption of hydrogen by charcoal, the Henrf's law is applicable. (Titoff, *Z. physik. Chem.*, 1910, LXXIV, 641). Recently, Magnus and co-workers (*Z. anorg. allg. Chem.*, 1928, CLXXIV, 142; 1929, CLXXIX, 215) have determined the sorption isotherms by purified charcoal and silica ge of carbon dioxide at low pressures and known that Henry's law is applicable.

SUMMARY.

The mechanism of the sorptions of gases by charcoal, silica gel and chabazite, etc., are discussed. The author's theory for these ases is as follows: The gas molecules enter into the molecular cavities in the solid body and form a homogeneous solid solution.

Chemical Institute,
Faculty of Science,
Tokyo Imperial University.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Photochemical Change of Certain Substances. By YUSHICHI NISHIZAWA.

Synthesis of Oxycumaranone. By JUNZO ARIMA AND TEIJI OKAMOTO.

A New Hypothesis on Hydroxyl and Carbonyl Radicals of Oxyanthrachinone and its Derivatives. By SOAI TANAKA AND KIYOSHI MORIKAWA.

Helium Content in Some Japanese Minerals. II. By JIRO SASAKI.

Essential Oil of Nothosmyrnium japonicum. II. Synthesis of Nothosmyrnol. By TAKEYU TAKAHASHI.

Sinomenine and Disinomenine. X. Synthesis of A, C, I, *s-Tetramethoxyphenanthrene. Chinones of Sinomenol Series.* By KAKUJI GOTO AND HIDEO SUZUKI.

A grant of £100,000 has been made by H.M. Government to the National Radium Trust Fund for augmenting the supply of radium to be used in Great Britain.

SMOKELESS COAL AS A MOTOR FUEL.

A remarkable demonstration of the harnessing of British coal products to agricultural power purposes took place on June 26, at Belmore Farm, Middlesex.

Coalite, the residual fuel of the low temperature carbonisation of coal, was used in a producer-gas plant fitted on an agricultural tractor, and for an hour and a half ploughing was carried out with marked steadiness and excellent results. The demonstration was arranged by the Parker Producer Gas Plant Co., and was witnessed by representative farmers, engineers and fuel experts. The company included Sir William Wayland, M.P. for Canterbury, and Chairman of the Empire Day Movement, Major J. McEwan Martin, of the Department of Overseas Trade, and representatives of the London General Omnibus Company, the National Farmers' Union, and leading motor manufacturers.

The object of the demonstration, stated the organisers, was to show that by means of the gas plant attachment it is possible to use the products of British mines—notably smokeless coal after the valuable by-products have been extracted—for agricultural power purposes and later on for heavy road transport. The Company had specialised in the application of the invention to the agricultural tractor which provided a more strenuous test than when the plant was fitted to a motor lorry. It had been found that coalite gave a higher engine efficiency than that obtained from paraffin, the fuel ordinarily used for such tractors. The engine beat was steadier and much quieter, there was no gas exhaustion or intermittent operation at any engine speed.

OTHER ADVANTAGES.

Other advantages claimed for the use of the gas producer plant are :—

The engine remains much cleaner.

The attachment of the producer to the vehicle is simply effected and cleansing chambers are substituted for the liquid fuel tanks.

The effect of the extra weight (8 cwt.) on a light-tractor keeps the head of the machine well down.

There is no undue heating and the inlet to the combustion chamber is cool after long periods of running.

Starting takes 15 minutes.

The problem of "clinkering" has been entirely overcome.

"The practicability of using low temperature carbonisation coke (smokeless fuel) as a motor fuel is of far reaching importance to Great Britain," stated an official of the Parker Company, in an interview after the demonstration. "Not only is another outlet provided for the residual fuel of low temperature carbonisation after the by-products of coal have been extracted, but economy of running is effected for heavy motor vehicles, farm tractors and farm power generally.

"Countless small stationary engines now using imported fuel will be able to use low temperature coke at a fraction of the cost of liquid fuel. Air compressors, small marine craft, and rail motors can all be driven by a home produced fuel. Depressed agriculture will be assisted by cheapening of the cost of power, while the problem of defence would be materially assisted by the use of British coal products, instead of seaborne fuels, for road transport and agriculture."

Demonstrations given earlier in the week were witnesses by representatives of the Ministry of Agriculture, the Ministry of Transport, the War Office, the Committee of Imperial Defence, the Fuel Research Board, the Mineral Resources Department of the Imperial Institute, the Institute of Fuel, and the Federation of British Industries.

Forthcoming Events.

THE INSTITUTE OF METALS.

The forthcoming Congress of metallurgists to be held in Düsseldorf from September 9-12 promises to be extraordinarily interesting. Already nearly 200 persons from all over Europe — and some from America—have indicated their intention to participate in the gathering.

The congress will comprise (a) the presentation and discussion of abolt 15 scientific and practical papers relating to metallurgical work; (b) visits to works in or near Düsseldorf and Berlin; (c) Receptions, dances and other social functions.

Persons who desire to participate in the congress should write for particulars without delay to the Secretary of the Institute of Metals, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

21,305.—Appareils et Evaporateuers Kestner. — Mixtures of nitrate of ammonia and nitrate of lime. July 11.

21,187.—Carreras, R. S.—Production of metallic hydroxides, etc. July 9.

21,225.—Carreras, R. S.—Treatment of complex ores of copper, etc. July 10.

21,012.—Calco Chemical Co., Inc.—Making sulphur trioxide. July 9.

21,211.—I. G. Farbenindustrie Akt.-Ges. —Production of diammonium phosphate for fertilisers. July 10.

Specifications Published.

314,819.—Patart, G., and Neilsen, H.—Decomposition of calcium carbide.

287,135.—Karpati, Dr. J., and Hubsch, Dr. M. G.—Manufacture of acetic acid from acetylene.

294,226.—Karpati, Dr. J., and Hubsch, Dr. M. G.—Manufacture of acetic acid from acetylene, and apparatus therefor.

314,916.—Hayward, E.—Apparatus for the continuous chemical, heat, or other treatment of materials.

288,154.—Kali-Industrie Akt.-Ges., and Thorssell, C. T.—Production of nitrogen and hydrogen.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

311,271.—Manganese dioxide.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Manganese dioxide containing from 90-100 per cent. MnO_2 is produced by heating manganese carbonate or bicarbonate or a mixture of the two to 250-600° C. in the presence of excess oxygen under a higher partial pressure than that of the oxygen in air at atmospheric pressure. Alternatively, the product obtained by roasting manganese carbonate in air at 250-450° C. may be used in the process. Oxygen or air enriched with oxygen may be used at atmospheric pressure

at 250-500° C., or air, or air enriched with oxygen at elevated pressure at 250-600° C. Decomposition may be eected in a heated tube by a counter-current stream of gas, and the latter may flow round a clised circuit comprising means to extract carbon dioxide, steam, or other undesired gases, and means for replenishing the supply of oxygen. Alternatively a pressure vessel may be employed. In examples manganese carbonate or a mixture thereof with the bicarbonate precipitated by sodium carbonate or ammonium carbonate or bicarbonate is treated at pressures of 1-100 atmospheres and temperatures of 270-550° C.; and an air roasted product containing 57.3 per cent. MnO is oxidised at 500° C. under a pressure of 25 atmospheres.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ZOOLEOL.

502,507.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes. — Pierre Zizine, 24, Rue de Fecamp, Paris, France. June 19.

BATTERIUM.

503,796.—Chemical substances used in manufactures, photography or philosophical research, and anti-rosives.—Walter Haddon, trading as John Haddon & Co., 182, Salisbury Square, Fleet Street, London, E.C.4. July 17.

502,386.—A device with a figure comprising a devil's head and body with horse's legs, and bearing the word COLARDO. Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—Colardo Products, Ltd., 57, Vastern Road, Reading. July 17.

502,428.—Illustration of a waterfall with the superimposed letters H. T. A.—Hypochlorites for use in manufactures.—The Mathieson Alkaliworks, 250, Park Avenue, City, County and State of New York, United States of America. July 17th.

PATENTS AND TRADE MARKS.

Any of our readers requiring information and advice respecting Patents, Trade Marks or Designs, should apply to Rayner & Co., Patest Agents, of 5, Chancery Lane, London, who will give free advice to readers mentioning *The Chemical News*.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—SOUTH AFRICA, 1929.

THE PRESIDENTIAL ADDRESS.

THE INTERNATIONAL RELATIONSHIP OF MINERALS.

By SIR THOMAS HOLLAND, K.C.S.I., K.C.I.E., LL.D., D.Sc., F.R.S., President of the Association.

A few years ago Members of this Association looked forward annually to a generalised statement of the results of their President's own research work in science. The rapid specialisation of science, with its consequent terminology, has, however, made it increasingly more difficult in recent years for any worker to express himself to his fellow-members.

Last year at Glasgow most of us expected that the hidden secrets of crystals would be revealed by one whose capacity for popular exposition accompanies a recognised power for extending the boundaries of science. Instead, Sir William Bragg released his store of accumulated thought on the relationship of science to craftsmanship in a way which gave each specialised work an opportunity to adjust his sense of relativity and proportion.

If I attempted now to summarise my scattered ideas on the outstanding problems of micro-petrology, I might possibly find half-a-dozen members charitably disposed to listen, and of them perhaps one might partly agree with my theoretical speculations. We have indeed to admit that the science of petrology, which vitalised geological thought at the end of the last century, has since passed into the chrysalid stage, but, we hope, only to emerge as a more perfect image in the near future.

Coincident with the excessive degree of specialisation which has developed with embarrassing rapidity within the present century, the problems of the Great War drew scientific workers from their laboratories, and forced them to face problems of applied science of wider human interest. And the atmosphere of this great mining field[1] stirs ideas of this wider sort—ideas concerning a field of human activity which, in recent years, has affected the course of civilised evolution more profoundly than seems to be recognised even by students of mineral economics. This must be my excuse for inviting you to consider the special ways in which the trend of mineral exploitation since the War has placed a new meaning on our international relationships.

With knowledge of the shortcomings which were felt during the war, in variety as well as quantity of metals, it was natural immediately after to review our resources, with the object in view of obtaining security for the future. But events have since developed rapidly, both in international relationships and in mineral technology. The evolution of metallurgy during the present century, and the developments in mining on which metallurgy depend, have placed new and rigid limitations on a nation's ability to undertake and maintain a war; consequently, the control of the mineral industries may be made an insurance for peace. Let us first consider briefly how these circumstances have arisen, how each country has passed from the stage of being self-contained in variety of the essential products to the most recent of all developments, the change to large-scale production that has tended to the concentration of the mineral and metal industries to certain specially favoured regions which will hold the position of dominance for several generations to come.

The names of Isis, Cybele, Demeter and Ceres seem to suggest that the ancient theologians in different lands formed the same conception of those peculiar conditions in prehistoric times which made it likely that a woman—tied for long periods to the home-cave—rather than a man, was the one who first discovered the possibility of raising grain-crops by sowing seed. Whoever it was who first made this discovery was the one who diverted the evolution of man along an entirely new branch, and so laid the foundation on which our civilisation was subsequently built—the beginning of what Rousseau called " Le premier et plus respectable de tous les arts."

Compared with this economic application of observational science, the later inventions, which seem so important to us—explosives, printing, the steam engine—were but minor incidents in the evolution of civilised activities. Previous uncertainty regarding the supply of the products of the chase, and the dangers which were necessarily attached to the collection of berries and edible roots in the jungle, became less important to the family man when it was found possible to raise food-supplies nearer home. This discovery was thus not one of merely material advantage; for it neces-

[1] The Witwatersrand.

sarily led to the idea of storage, and so opened up a new mental outlook for primitive man.

But then this new possession of field-crops —the acquisition of cultivated real-estate—created fresh cares and new anxieties, which contained the germ of future political problems. In addition to the previous dangers from nomadic hunters and predatory carnivora, new troubles arose from other enemies —herbivorous animals, birds, insects, droughts and floods.

The formation of village-groups for protection, and the development later of tribal communities resulted necessarily in the radial extension of field "claims"—what our modern politicians, with careless disregard for geometrical terminology, now call "spheres of influence"—always dominated by the extending necessities of agriculture, the growing of crops for foods and then, with the scarcity of skins, for textile materials.

The mineralogist and the metallurgist were perhaps before the farmer among those earliest research workers in applied science; but they wer esmall folk, mere specialists in science. They have obtained a place of undue prominence in the minds of our modern students because of the adoption of the products for purposes of terminology in our conventional timescale for those ages that preceded history. But this is due merely to the durability of impréments as index "*fossils*" and is in no sense a certain indication of their political and industrial importance.

And then afterwards, long afterwards—indeed, up to historically recent times—national boundaries became extended or were fought for, but still mainly because agricultural products in some form were a necessity for the maintenanee of communal life. When British traders first went to India, for instance, they extended their influence first along the navigable rivers for the trade in vegetable products which were raised on the alluvial lands around; and so British India, as we call it to-day to distinguish the administered areas from the residual native States, is now mainly agricultural. Even when the permanent settlement of Bengal was made in 1798 no one thought of reserving for the State the underlying coal which has since become so surprisingly important. It was the field, and the field only that was considered to be of commercial and political importance.

Agricultural products, therefore, until recently dominated the political ambition of national units. Whether, and to what extent, the possession and use of mineral resources may now modify the dominant spirit is the principal question to which I wish to invite your attention this evening.

In the evolution of man, as in the evolution of the animals that occupied the world before him, there are no sharply defined, world-wide period limits: the pre-agricultural Bushman still survives and lives the life of pre-agricultural man in this Union of South Africa. The recognition of agriculture as a leading inspiration for acquiring and holding territory has been modified occasionally by "gold rushes" into lands previously unoccupied, but they have generally had a temporary, often a relatively small, importance. The "gold fever" may be what our lighter species of newspaper calls "dramatic," but a fever is a short item in the life of a healthy man; heat-waves do not make climates. Possibly our school children are still told that Australia is noted for its goldfields, but the whole of the gold produced there since its discovery in 1851 is less in value than that of three years' output of Australian agriculture.

Even here in South Africa, which produces half the world's supply of gold, the value of the metal is still less than that of the pastoral and agricultural products. It is true that gold and diamonds introduced temporary interests in the political expansion of South Africa, but the dominant interests of the Union are still determined by the *boer-plaas* and the *wieveld*.

The adventures of the Spanish *conquistadores* in the sixteenth century and of their enemies, the sea-roving Norse *buccaneers*, were inspired by stories of gold in El Dorado. And yet the whole of the South American output of gold, even under its modern development, is almost negligible beside the pastoral and agricultural products —wheat, maize, wool, tobacco, coffee, cocoa, sugar, meat and hides. The total production of gold for the whole continent last year was worth no more than a hundredth part of the surplus of agricultural products which the Argentine alone could spare for export. Truly there is a substantial difference between the bait and the fish, between the sprat and the mackerel.

The discovery and colonisation of a continent are not the only ways in which the lure of gold has often brought results more valuable than the metal itself. The efforts of philosophers from the time of the Alexandrian Greeks in trying to transmute the base metals into gold resulted in accumulating

the raw materials with which Paracelsus laid the foundations of a new chemistry.

Metals, we know, have been used since early times for simple implements and weapons, but it was not until the industrial revolution in Great Britain that the mechanisation of industries led to any considerable development of our mineral resources, first slowly and with a limited range of products, then on a large scale and with an extended variety.

But to distinguish clearly cause from effect is not always simple. We were told at school of the remarkable series of inventors who laid the foundation of the textile industries in the North of England, and of the timely invention of the steam engine; its application to mine pumping; the successive construction of the steamer and the locomotive; the production of gas from coal. But the close association of ore, fuel and flux made it possible not only to improve machinery, but to increase facilities for the transport of raw materials and their products. When Josiah Wedgwood obtained his inspiration from the remains of Greek art, then being unearthed from the ancient graves of Campania, he first turned to account the raw materials of his native county of Staffordshire, and then promoted canal and road construction to introduce the china clay from Cornwall.

It is obvious that the growth, if not with equal certainty the origin of the industrial revolution was due to the close association of suitable minerals in England. It was because non-phosphoric ores were still available that, at a later stage, Bessemer was able to give that new impetus which increased the lead of the English steel maker; and so, when Thomas and Gilchrist came still later, with their invention of a basic process applicable to pig-iron made from phosphoric ores, their invention fell on barren soil in Britain. The new process, however, found applications elsewhere, and, instead of adding to the stability of the English steel industry, it gave the United States the very tonic they required, whilst the industrialists of Germany—where political ideas were then established—found the opportunity of developing the enormous phosphoric ore deposits of Alsace-Lorraine, which had been borrowed from France eight years before. And so it was through the genius of Sidney Gilchrist Thomas, and his cousin, Percy Carlyle Gilchrist, that Germany was enabled in 1914 to try the fortune of war.

For the first half-century after the industrial revolution, Great Britain was able to raise its own relatively small requirements of iron as well as of the other metals that consequently came into wider use—copper, zinc, lead and tin. The rapid expansion in steel production which followed Bessemer's announcement of his invention at the Cheltenham meeting of the British Association in 1856, brought with it the necessity of going further afield for the accessory ores and for further supplies of non-phosphoric iron ores.

The next important step in metallurgical advance came in 1888, when Sir Robert Hadfield produced his special manganese-steel; for this led to the production of other ferro-alloys, and so extended our requirements in commercial quantities of metals which were previously of interest mainly in the laboratory—vanadium, tungsten, molybdenum, aluminium, chromium, cobalt and nickel. The adoption of alloys, especially the ferro-alloys, at the end of the last century opened up a new period in the newly established miner era of the World's history; for, beside the increase in the quantity of the commoner base metals which were wanted for the growing industries of Great Britain, it was necessary now to look further affeld for supplies of those metals that had hitherto been regarded as rare in quantity and nominal in value.

The country in which the industrial revolution originated and gathered momentum, because of the close association of a few base metals, could no longer live on its own raw materials, and never again will do so. Even in peace time Great Britain alone consumes twice as much copper and just as much lead as the whole Empire produces. Meanwhile, developments had occurred elsewhere, notably in Germany, where political stability had been secured, and in the United States, where the Thomas-Gilchrist process also had stimulated expansion. Thus, by the beginning of the twentieth century, the industrial activities of the World had entered a new phase, which was characterised, if not yet dominated, by the necessity for minerals to maintain the expanding Arts of Peace.

From this time on no nation could be self-contained; a new era of international dependence was inaugurated, but the extent and the significance of the change was not consciously realised by our public leaders until 1914, when it was found that the developments of peace had fundamentally changed the requirements for war. Indeed,

not even the German General Staff, with all its methodical thoroughness, had formed what the tacticians call a true "appreciation of the situation." Two illustrations of shortsightedness on both sides are sufficient for the present argument. Up to the outbreak of war, although the wolfram deposits of South Burma were worked almost entirely by British companies, the whole of the mineral went to Germany for the manufacture of the metal, tungsten, which was an essential constituent of high speed tool steel. Sheffield still occupied a leading place in the production of this variety of steel, but was dependent on Germany for the metal, which the Germans obtained mainly from British ore. Under the compulsion of necessity, and without consideration of commercial cost, we succeeded before the middle of 1915 in making tungsten, whilst Germany, failing to obtain an early and favourable decision in war, used up her stocks of imported ore and turned to the Norwegian molybdenum for a substitute, until this move again was partly countered by our purchase of the Norwegian output. Germany then found that she wanted ten times more nickel than Central Europe could produce; so she imported her supplies from the Scandinavian countries, and they being neutral, obtained nickel from another neutral country, where the Canadian ores—the world's main source—had hitherto chiefly been smelted and refined. We thus realised, not only our dependence on other lands for the essential raw minerals, but we had the mortification of finding that, through our own previous shortcomings in the metallurgical industries, we were compelled to face lethal munitions made of metal obtained from our own ores.

The political boundaries of the nations, originally delimitated on considerations dominantly agricultural in origin, have now no natural relation to the distribution of their minerals, which are nevertheless essential for the maintenance of industries in peace time as well as for the requirements of defence. This circumstance, as I hope to show in the sequel, gives a special meaning to measures recently resigned on supplementary lines in Europe and America for the maintenance of international peace, measures which, as I also hope to show, can succeed only if the facts of mineral distribution become recognised as a controlling feature in future international dealings.

If minerals are essential for the maintenance of our new civilisation, they are, according to the testimony of archæology and history, worth fighting for; and if, according to the bad habits which we have inherited from our Tertiary ancestors, they are worth fighting for, their effective control under our reformed ideas of civilisation should be made an insurance for peace. In so attempting to correlate the facts of mineral distribution with questions of public policy, there is no danger of introducing matters controversial; everyone here must agree on two things, namely, our desire and even hope for international peace, and consequently the necessity of surveying the mineral situation as developments in technological science change the configuration of the economic world.

Since the industrial revolution in Great Britain, the increase of mechanisation and consequent consumption of metals has been accelerated with each decade. It is not necessary to quote the statistical returns available for estimating the rate of this acceleration, for it can be expressed in a single sentence which justifies the serious consideration of every political economist: during the first quarter of this present century alone, the world has exploited and consumed more of its mineral resources than in all its previous history, back to the time when Eolithic man first shaped a flint to increase his efficiency as a hunter.

To save you from the narcotic effect of statistical statements, I will limit myself to one illustration of this generalised statement; for this special example not only illustrates the rate of general acceleration in exploitation, but introduces an important subsidiary question, namely, the way in which activity is becoming pronounced, if not substantially limited, to a group of special areas. In the year 1870 the United States produced 69,000 tons of steel; in 1880, 1¼ million tons; in 1890, 4½ millions; in 1900, 10 millions, and in 1928, 45 millions.

Figures like these raise questions regarding the future which would take us beyond our present thesis. For the present we can assume with fair confidence that, taking the world as a whole, the depletion of natural stores is not yet alarming, although the rate of acceleration, by reason of its local variation, forces into prominence some international problems, which will influence, and if effectively tackled will facilitate, the efforts to stabilise conditions of international relations.

(To be continued.)

AFRICA AND SCIENCE.

Address by Jan H. Hofmeyer, M.A., President of the South African Association, on the occasion of the Inaugural Meeting in Cape Town, July 22, 1929.

(*Continued from page 58.*)

Science in South Africa, then, has made itself truly South African, and in doing so it has established itself in the admiration and affection of the people of this land. As a nation we are grateful to our scientists for their contributions to our intellectual and material progress. The liberal policy of the state in supporting scientific effort we heartily endorse, the increase in the mental stature and the prestige of the nation which Science brings to us we sincerely welcome. We are proud of our South African Science, not least because we know that we can regard it as distinctively ours. But while our Science has been South Africanised, we can rejoice that there is nothing narrow about its South Africanism. Were it otherwise, it would have been false to the spirit of Science. In applying itself to the problems of South Africa, it has succeeded in attracting the attention of the scientific world to South Africa. In that address to which I have already referred, General Smuts emphasised the fact that recent events had drawn the eyes of the world to this land of ours as a rich field for scientific investigation. "The scope for scientific work," he said, "in this department of knowledge" (he was referring more especially to Human Palæontology, but his words are of wider applicability) "is therefore immense; the ground lies literally cumbered with the possibilities of great discoveries . . . Science has in South Africa a splendid field of labour; other nations may well envy us the rich ores of this great 'scientific divide' which is our heritage." Those words are well worth remembering. We speak sometimes of our wealth in South Africa—mineral wealth, agricultural wealth, and great is the debt we owe to South African Science for what it has done to reveal that wealth to ourselves and to the world.

There, then, in brief outlines, all too imperfectly drawn, is a picture of South African Science in 1929. Contrast it with the picture of 1905, and you have the measure of the achievement of a great epoch. Science consolidated, Science South Africanised, Science recognised as of great national value, both in the spiritual and in the material spheres, Science drawing to our country the eyes of the world—surely that is no unworthy achievement. And as to-night, once again after the lapse of many days, our Association makes its report to the parent body, to which it gladly pays the tribute of filial reverence, it does so with pride and satisfaction in the work of the intervening period, but also with grateful recognition of the inspiration which that visit of 1905 brought to South Africa as one of the constitutive factors in the progress of the last quarter of a century.

And now it has been our privilege to welcome this second visit of the British Association. Is it strange if we ask ourselves, as we gratefully remember the stimulus of 1905, what will be the stimulus of 1929? That visit had abiding results. What will be the results of this one? That visit inaugurated a new epoch. Are we not justified in believing that once again we stand on the threshold of a great advance? If that be so, what are to be the characteristics of the period on which we are now entering, what will be its achievment? In the period that followed the first visit of the British Association we South Africanised Science in South Africa. Is it too much to hope that in the next we shall Africanise it? Will not this visit perhaps give us the impulse and the inspiration to a bigger and a bolder enterprise One of the most significant tendencies evidenced in South Africa in the last few years has been the growing consciousness of our obligations in relation to the ontinent of Africa. We have come to realise that the position of this European civilisation of ours set upon the verge of this great continent is a position of unique strategic importance, that it presents us with at once an opportunity and a challenge. While in the past we thought, as a nation, almost exclusively of our own problems and difficulties, we are now ceasing to limit our horizon by the Limpopo, we are beginning tot envisage the task that awaits us beyond our own borders. And in the mind of the nation there is being developed a new conception of South Africa, of a South Africa that consciously and deliberately seeks to play its part on the African continent, not aiming at conquest or domination, but never failing in its readiness to give its intellectual and material resources to aid all who are engaged in the task of developing this great undeveloped area of the earth's surface, which is so full of potentialities for the future welfare of the world. If then South Africa aspires to leadership in Africa in other branches of activity, why not also in Science? If the outlook of the nation is

broadening, why should not its scientists also begin to think in continents? If as a people we are anxious to make our contribution to Africa, eager to give it of our best, rather than to get from it that which will be to our material advantage, why should not our Science also become consciously and deliberately African in its outlook, its ideals, and the tasks to which it applies itself. If Science has consolidated its position in South Africa, as we believe it has, is it not fitting that, with South Africa as its base, it should enter now into the new sphere of opportunity and achievement which stretches mightily outwards from its borders?

To you, our visitors, I look to give us the stimulus and the encouragement to that enterprise. You have come to Africa. This great land-mass which has reared itself against time's passage, almost since time's beginning, and holds inviolate so many of the records of that passage, has challenged your attention. You have come to Africa to seek new inspiration for the study of the problems that interest you, by seeing them against a different background which has for many of you an unaccustomed vastness. But while Africa was your goal, you did not think fit to enter it at the point nearest to your homes. You steamed down, day after day, skirting the long coast-line of this vast expanse of veld and forest, and have entered it by its Southern gateway. For a great body of scientists, it is the only point of effective entry into Africa. It is by way of this Southern gateway that Science itself can most effectively be made to permeate Africa. And to you, having so come, to you, the ambassadors of Science, I present—Africa. It is Africa and Science, which, I like to think, are to-day met together. Happy indeed should be the fruits of the mating.

It is to that theme—Africa and Science—that I propose now to invite your attention. What can Africa give to Science? What can Science give to Africa? Those are the questions to which I would address myself. But as I speak, I would ask you all to remember, that it is for the South African scientist that the answers to these questions have primary significance. It is for him that they have significance, because for the solution of many of the problems of South Africa a greater knowledge of Africa as a whole than is at present available is essential, and the extension of that knowledge is his personal responsibility. It is for him that they have significance because he dwells in a land which is strategically placed for attacking the problems of Africa and for drawing forth its hidden resources of scientific discovery for the enrichment of Science throughout the world.

What then can Africa give to Science? In reply to that I can do no more than suggest some of the lines along which Africa seems to be called upon to make a distinctive contribution to Science.

First there are the related fields of Astronomy and Meteorology. To Astronomy I shall but make a passing reference. This continent of Africa, more especially the highlands of its interior plateau, with its clear skies and its cloudless nights, offers wonderful facilities to the astronomer. As proof of the necessity of utilising those facilities, especially with a view to the study of the Southern heavens, I need but quote the words used by Professor Kapteyn on the occasion of the 1905 visit: "In all researches bearing on the construction of the universe of stars, the investigator is hindered by our ignorance of the Southern heavens. Work is accumulating in the North, which is to a great extent useless, until similar work is done in the South." Africa has to its credit considerable achievements in the past in the field of astronomical research. The increased equipment now available should make it possible to increase greatly the amount of systematic work now being done, and to ocen important contributions to astronomical science.

But probably of greater importance is the work waiting to be done in Meteorology. Few branches of Science have a more direct ecect upon the welfare of mankind—that is a lesson which we in South Africa should have learnt only too well—but in few has less progress been made. And in meteorological work Africa is probably the most backward of the Continents. It is not so long since Dr. Simpson, of the London Meteorological Office declared that, save from Egypt, his office received practically no meteorological information from the great continent of Africa. Moreover, the backwardness of Meteorology is in large measure due to the intricacy of the problems involved, and the necessity of having world-wide information made available. The problems of Meteorology are emphatically not the problems of one country or of one region. The South African meteorologist must see his problems *sub specie Africæ* (the seasonal changes in South Africa depend on the northward and southward oscillations of the great atmospheric system overlying the continent as a whole); and quite apart from

what he can learn from the rest of Africa, the Antartic regious have much to teach him. But while the development of meteorological research throughout Africa is of supreme economic importance for Africa, Africa in its turn has its contributions to make to other continents. Iu particular, should we not forget the close inter-relation of the meteorological problems of the lands of the Southern hemisphere. The central position of Africa in relation to those lands gives not only special opportunities, but also special responsibilities for meteorological observation and research. For the sake both of South Africa and of Science in general I would venture to express the hope that this second visit of the British Association will give as powerful a stimulus to Meteorology as did the first to Astronomy.

Next, I would refer to Africa's potential contributions to Geological Science. Africa is a continent, portions of which have always had a special interest for the geologist because of the great diversity of the geological phenomena manifested, and the vast mineral wealth which, as its ancient workings so abundantly prove, has attracted man's industry from the very earliest times. But in our day the opportunities which it offers to the geologist to make contributions to the wider problems of Science are coming to be more fully realised than ever before. Of special interest in this connection is the light which African Geology, more especially in the form of the study of ancient glacial deposits, can throw on the Wegener hypothesis of continental drift. In the past our geologists have thought mainly of the correlation of our formations with those of Europe. It is time that they paid more attention to their possible affiliations with those of the continents to east and west of us. If Geology can establish the hypothesis that Africa is the mother continent from which India, Madagascar, and Australia on the one side and South America on the other have been dislodged, it will give a new orientation to many branches of scientific activity. For that investigation also Africa occupies a central and determinative position in relation to the other continents, such as we have noted to be the case in the sphere of Meteorology. There are many other geological problems on which Africa can probably shed much light. There is, for instance, the constitution of the earth's deeper substrata, in regard to which, as Dr. Wagner has recently pointed out, the study of the volcanic Kimberlite pipes, so numerous throughout Africa south of the Equator, and of the xenoliths they coutain, may be of the greatest significance.. There is the possibility that the exploitation of Africa's great wealth in poteutially fossil-bearing rocks of presumably pre-Cambrian age will yet yield us remains of living beings more primitive than any yet discovered; there are the great opportunities of study which the African deserts offer in the field of desert Geology and Morphology, and there is the assistance which African Geology has rendered to vertebrate and plant Palæontology, and can render to African Anthropology in the investigation of this great museum of human remains and relics, which we call the continent of Africa.

(To be continued.)

NEW METHODS IN THE PREVENTION OF DIPHTHERIA.

By J. Pratt-Johnson ,M.B., B.S. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Oxon.), Director, Clinsearch Laboratories, Johannesburg.

(Abstracted from the *South African Journal of Science.*)

Observations on affections of the throat, which probably included diphtheria, date back possibly as early as Hippocrates in the 5th century B.C., and also appear in the 2nd century A.D., in the writings of Aretaeus of Cappadocia on "Ulcerations about the tonsils." Diphtheria was, however, first recognised as a specific disease by Bretonneau more than 100 years ago, although it was not until 1884 that Klebs and Loeffler discovered the specific bacillus. Diphtheria may be described as an infectious disease chiefly affecting infants and children, characterised by an acute inflammation of the throat and nose, associated with a yellowish white membrane which may extend into the windpipe and so cause suffocation—hence the name given to it in the 18th century—"angina suffocativa." A general blood poisoning also occurs due to the absorption of the potent poison known as diphtheria toxin.

Incidence of the Disease in South Africa.

In the Union of South Africa the number of cases of diphtheria notified has shown a notable increase, which suggests that there has been a marked rise in the incidence of the disease during the last five years.

Number of notifications in 1923, 885; in 1924, 1,087; in 1925, 1,201; in 1926, 1,286; in 1927, 1,842.

The notification figures for 1927, set out by areas, are as follows :—

	Europeans	Non-Europeans
Cape	529	207
Transkei	4	1
Natal	201	37
O.F.S.	70	23
Transvaal	247	23
Total	1,051	291

To what extent diphtheria is prevalent among the native and coloured population is difficult to estimate, because many cases of the disease are never seen by a medical man, and are consequently not notified. In the Transkei, out of a native population of 948,138, only one case was notified during 1927, although four cases were notified as occurring in Europeans who number 14,676 in that area. The incidence of the disease among the native and coloured population which supplies the domestic servant and industrial labourer in South Africa is of obvious importance, as increasing considerably the risk to the European population from non-European carriers of virulent disease germs. It is clear, therefore, that the question of the prevention of diphtheria is one of considerable importance in South Africa.

Diphtheria Antitoxin.

The discovery of the specific antidote for diphtheria—" antitoxin "—by E. Behring and Kitasato in 1890, constitutes one of the most important achievements in modern medicine. It was shown that, when diphtheria toxin artificially prepared in the laboratory is injected into horses in gradually increasing amounts, the animal's tissues acquire tolerance and there is produced in the blood a protective substance known as antitoxin, which has the power of neutralising and rendering harmless diphtheria toxin. This important discovery has been utilised with markedly successful results in the treatment of diphtheria, serum being obtained from immunised horses, which is then inoculated into the diphtheria patient. The toxin in the patient's blood and tissues is neutralised by the antitoxin much in the same way as acids and alkalis neutralise one another, and the disease is robbed of its most dangerous factor—the toxin—which, by its action on the nerves, heart and blood vessels, threatens the life of the diphtheria patient. If the administration of antitoxin is too long delayed owing to the fact that the disease has been unrecognised, then much of the toxin becomes " fixed " by vital structures, and the antitoxin may be powerless to prevent a fatal issue. Insufficient dosage to neutralise all the toxin is yet another cause of failure in treatment. It is owing to these facts that the antitoxin treatment has not met with the complete success that was at first anticipated, many cases of diphtheria being discovered too late for effective and successful treatment.

Now, it is a matter of common experience that although diphtheria is most liable to occur in young children, all do not get the disease. This matter has been investigated, and it has been found that children who, in the presence of an epidemic, do not contract the diseasefi are those whose blood contains a definite amount of antitoxin which has been produced by previous subinfective doses of the diphtheria germs. These children are known as immunes and do not need protective inoculation. Children in whose blood antitoxin is absent are susceptible to diphtheria, and are classed as non-immunes. The first step, therefore, in the control of diphtheria is sorting out into two groups (*a*) the immunes, (*b*) the non-immunes.

The Schick Test.

This is carried out by means of a simple test known as " The Schick Test," which was introduced in 1913, by Schick, and consists in the inoculation into the skin of a tiny drop of fluid containing a measured test dose of diphtheria toxin, so minute as to be quite harmless. In the case of immunes, the antitoxin present in their blood neutralises the test dose of toxin, so that a negative reaction is obtained. In those susceptible to diphtheria, who have no antitoxin in their blood, a small red blush appears in about 24 hours about the size of a sixpence due to the local irritation set up by the free toxin—a positive reaction. In children under 6 the test is practically always positive, so that it is usual to omit the Schick Test in children up to 6 years, all such being treated as non-immunes. In all other cases a preliminary Schick Test, to decide if the individual is susceptible or not to diphtheria, is advisable.

The Schick Test shows that about 85 per cent. of infants under 8 months are immune to diphtheria, but as a child grows, it loses its immunity so that about 60 per cent. of children aged 6-12 months are susceptible, while at 2 years the percentage of non-immunes has increased to 70 per cent. From 2 years onwards the number of immune individuals gradually increases until adult

life when 85 per cent. of persons of 20 years and over are immune. The usually accepted explanation of these facts is that the new born infant has derived from its mother the antitoxin which gives it immunity, that it loses its antitoxin in a few months, and that the antitoxin is slowly regained owing to slight but frequently repeated infection with diphtheria germs, which are in insufficient numbers to cause a recognisable attack of the disease.

PROPHYLACTIC INOCULATION.

The difference between the immunes and the non-immunes is clearly the presence or absence of antitoxin in the blood. The problem of prevention is, therefore, by what means can antitoxin be produced in the blood of the non-immunes? This can be most effectively achieved by the inoculation of diphtheria prophylactic which is prepared from toxin rendered harmless either by chemical or other means, a procedure which is controlled by exhaustive animal tests. It is the same method, suitably modified, which is used for the preparation of antitoxin in horses. Antitoxin is produced in the blood in this way by inoculation, thereby rendering the subject immune. The injection produces trivial effects in infants and young children; in older children and adults a more marked reaction takes place, which, however, is little more than a sore arm for a few days. The most important point, apart from the harmlessness of the inoculation, however, is the duration of the protection. Immunity once established lasts at least 10 years, and probably for life. The lasting nature of the immunity compares very favourably with antityphoid inoculation, the protection from which lasts about 12 months, necessitating inoculation every year, as many will remember was the practice during the Great War and is still continued, under certain circumstances in the Army, Navy and Air Force.

GENERAL.

The simplicity of these new methods and their reliability has led to their adoption in America and Europe and in all countries throughout the world. In South Africa the researches carried out at the Clinsearch Laboratories on test toxin for the Schick Test and diphtheria prophylactic prepared at these laboratories fully confirm the work done in other parts of the world. This prophylactic is harmless even to guinea pigs, which are not affected by as much as a hundred human doses. Inoculated guinea pigs are enabled to withstand at least five times the fatal dose of diphtheria toxin for the guinea pig.

The preparation used for prophylactic inoculation against diphtheria in the earlier work were definitely toxic preparations, and difficulty arose owing to the lack of stability of some of these preparations and the marked reactions following their use. In recent years, however, these difficulties have been overcome, and it has been proved conclusively that a highly satisfactory immunity can be produced by a harmless prophylactic, which is stable and completely non-toxic as proved by animal tests, and which produces but little local or constitutional reaction. Moreover, stringent regulations have been introduced to ensure that diphtheria prophylactic, before being issued for use, has been submitted to exhaustive animal tests, so that a standard of potency and reliability and safety can be absolutely guaranteed. It is these recent improvements in the preparation of diphtheria prophylactic which makes it possible to fully recommend the method to the careful consideration of all parents.

It is the opinion of a large number of authorities in different parts of the world that the Schick Test and immunisation against diphtheria constitute one of the most notable advances in the sphere of preventive medicine. The large body of evidence now available leaves no doubt that the disease and its often fatal consequences may now fairly be called avoidable. A well organised co-ordinated effort on the part of those interested in health, education and child welfare, is long overdue in South Africa to make the facts clearly known to parents as to the means of safeguarding their children from the menace of diphtheria, which has been shown to have greatly increased in South Africa during the last five years. The systematic adoption of Schick testing and immunisation against diphtheria in South Africa would undoubtedly result in a great yearly saving of child life.

SUMMARY.

1. Diphtheria is an infectious disease chiefly affecting infants and children, characterised by an acute local inflammation of the throat and nose, associated with a yellowish white membrane, which may extend into the windpipe and so cause suffocation. A general blood poisoning also occurs, due to the absorption of a potent poison known as diphtheria toxin.

2. An effective antidote—" antitoxin "—which neutralises and renders harmless diphtheria toxin is produced by inoculating toxin into horses. The horse's serum, containing antitoxin, is inoculated into the diphtheria patient, with greatly beneficial

results. The treatment is not successful in cases where antitoxin is given in the later stages of the disease, and where insufficient dosage is employed.

3. Not all children exposed to the risk of infection develop the disease. It has been found that children who are immune have in their blood antitoxin, doubtless due to previous contact with diphtheria germs. Antitoxin is not found, however, in the blood of non-immunes.

4. A simple test, the "Schick Test," readily separates the immunes from the non-immunes. A drop of fluid containing a measured dose of toxin, so minute as to be quite harmless, is inoculated into the skin of the forearm. In the immunes the toxin is neutralised by the antitoxin in the blood, and no reaction follows. In the non-immunes a small blush, the size of a sixpence, appears in 24 hours due to the irritating action of the free toxin—a positive reaction. Only the positives need preventive inoculation. In children between one and six years Schick testing may be omitted, as they are usually positives.

5. The non-immunes are inoculated with diphtheria prophylactic, which is prepared from toxin rendered harmless by chemical or other means. The new preparation can be fully guaranteed as to its safety and efficiency. Antitoxin is thus produced in their blood, conferring an immunity which, once established, lasts for at least ten years, and probably for life.

6. The simplicity of these new methods and their reliability has led, during the last ten years, to their extensive introduction in America and Europe, and in almost all parts of the world.

7. During the last five years the number of cases of diphtheria notified in the Union of South Africa has increased by 50 per cent. To what extent this disease is prevalent among the native and coloured population is difficult to estimate, because many cases are never seen by a medical man, and are consequently not notified.

The time has now come for concerted action in South Africa on the part of those interested in health, education and child welfare, to make the facts clearly known to parents, and especially mothers, as to the means of safeguarding their children from the menace of diphtheria. The systematic adoption of Schick testing and immunisation against diphtheria in South Africa would undoubtedly result in a great yearly saving of child life.

GENERAL NOTES.

SMELTING AND REFINING IN CANADA.

A statement issued by the directors of Sherritt-Gordon Mines, Ltd., indicates that the entire processes of smelting and refining of the ores from the big copper-zinc-gold-silver property in Northern Mantoba will be carried out in Canada. The smelter being erected at Flin Flon, Manitoba, will treat the copper concentrates and the blister copper produced there is to be refined at Sudbury, Ontario, while zinc concentrates will be treated at the new electrolytic zinc plant to be erected by Ventures, Ltd., and the Consolidated Mining and Smelting Company in Eastern Canada.

Arrangements have also been made for electrical power for the mining and concentrating of Sherritt-Gordon ores, the power to be furnished from the new hydro-electric station under construction at Island Falls on the Churchill River.

The following is the official statement :

" A mutually satisfactory arrangement has been arrived at between Sherritt-Gordon Mines, Ltd., and the Hudson Bay Mining and Smelting Company, Ltd., whereby the latter will treat all copper concentrates of the former company at their smelter at Flin Flon. It has also been arranged that the power needed for the mining and concentrating of Sherritt-Gordon ores will be furnished by the Hudson Bay Mining and Smelting Company from its power plant at Island Falls.

" The Sherritt-Gordon zinc concentrates will be treated at the electrolytic zinc plant to be erected in the east, jointly by Ventures, Ltd., and Consolidated Mining and Smeltng Company.

" The Sherritt-Gordon proportion of the blister copper produced at the Flin Flon smelter will be shipped to the refinery now being erected at Sudbury, Ontario."

ANNUAL REPORT ON THE MINING INDUSTRY OF BRITISH COLUMBIA.

The High Commissioner of Canada in London has received from the British Columbia Department of Mines the Annual Report for the year ended 31 December, 1928, from which it appears that increased production, widespread development and satisfactory profits were the outstanding features of the mining industry of the Province during the

The Report shows that the past year can be described as the most successful in the history of the mining industry in Canada's Pacific Coast province. While, owing to the lower level of metal prices, the aggregate value of the output of $65,372,583 was $1,816,239 less than for the record year of 1926, on the other hand the aggregate output of metals and minerals was the greatest on record, the tonnage of metalliferous ore mined and treated in 1928 being 6,241,310 tons compared with 5,416,621 tons in 1927 and with 4,775,173 tons in 1926. In fact the 1928 production valued at 1926 prices would be worth nearly $75,000,000.

Compared with 1927, the production figures for 1928 show increased output for all metals except placer gold, a large tonnage of coal, and increased valuations of structural materials and miscellaneous metals and minerals.

Copper, lead and zinc are British Columbia's most valuable metals in point of value of total output. In all three new production records were established, copper with 97,908,316 pounds valued at $14,265,,242 compared with 89,202,871 pounds valued at $11,525,011 in the previous year. An increase of over 22,000,000 pounds is shown in lead production, the output for 1928 being shown as 305,140,972 pounds; the value for last year at $13,961,412, however, represents a reduction from the 1927 output of $14,874,292. A very large increase is shown in zinc output from 145,225,443 pounds in 1927 to 181,763,147 pounds last year. The value of zinc output increased from $8,996,135 to $9,984,613 despite the lower prevailiug prices for this metal.

Coal ranked ahead of zinc being third in order of value among British Columbia's products of the mining industry. A slight increase is recorded in output with 2,526,702 tons mined worth $12,633,510. The extent to which silver and gold contributed to the total value of output from the mines is shown by a production of 10,627,167 ounces of silver valued at $6,182,461 and 188,087 ounces of lode gold worth $3,888,097. Gold from placer mining added 8,424 ounces valued at $143,208.

Increasing demand for structural materials consequent upon the great increase in building operations is reflected in the value of the structural materials produced. Production in 1928 was valued at $3,408,686 as compared with $2,867,880 in 1927, an increase of $541,806 or 18.8 per cent.

An encouraging feature of the mining operations, it is pointed out, was the growth in output of miscellaneous metals and minerals which in 1928 were valued at $905,354, compared with $459,514 in 1927 and $332,583 in 1926. The extent to which cadmium, a new product from British Columbia's mines, entered into the increased production is shown by an output of this metal valued at $341,374.

The Report points out that British Columbia mines had yielded an aggregate of $1,114,210,411 up to the end of 1928. Information is also given on the dividends declared by the leading mining Companies during 1928, these aggregating $11,556,688 compared with $10,800,838 in 1927. The recent growth in dividends paid in recent years is strikingly shown by a table which indicates the quadrupling of these annual payments to shareholders since 1923, when $2,809,295 was paid out. A dividend record of $11,556,688 from a gross production of $65,372,583 or 17.7 per cent. is an excellent one and shows that mining in British Columbia is a profitable industry.

THE PRODUCTION OF COPPER.

According to finally revised statistics on the production of copper in Canada during 1928, just issued by the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics at Ottawa, production reached a total of 202,696,046 pounds, valued at $28,598,249 as compared with 140,147,440 pounds valued at $17,195,487 in 1927. This was an increase of 45 per cent. in quantity and 66 per cent. in value and marked the attainment of the largest output ever recorded for the Dominion. In 1928 Canada was the world's fourth largest copper producing country, being exceeded only by the United States, Chile and Africa. Increases in production were noted in all copper-producing provinces and much development work was carried on in Manitoba where large copper deposits are being rapidly brought to the production stage. The Horne Copper Corporation is the principal producer in Quebec; the International and Mond Nickel Companies were responsible for practically all of Ontario's output; the Granby Consolidated Mining, Smelting and Power Company, Ltd., which operates mines at Hidden Creek and Copper Mountain, B.C., and the Britannia Mining and Smelting Company, Ltd., operating the Britannia mine on Howe Sound, produce the larger part of the output from British Columbia. A small amount of copper is contained in the silver-lead ores exported from the Yukon Territory. Blister copper was made by the Granby Consolidated at Anyox, B.C., by the

Consolidated Mining and Smelting Company at Trail, B.C., where it was also refined; at Port Corborne, Ontario, by the International Nickel Company and at Noranda, P.Q., by the Horne Copper Corporation.

Ores from the Britannia mine in British Columbia, and the Eustis in Quebec, were exported to the United States for treatment. Ores from Copper Mountain were smelted at Trail during the first part of 1928 and at Tacona, U.S.A., during the latter part of the year.

BRITISH ASSOCIATION MEETING IN CAPE TOWN.

Presidential addresses in the various sections this year are not lacking in popular or scientific interest, and there is promise of general appeal in the public lectures, such as that of Sir Ernest Rutherford on " The Structure of the Atom," and Professor Julian Huxley's address on " Evolution " on Friday.

There will be a public discussion on " Science and Industry," at Cape Town, with Professor D'Arcy Thompson and Sir Richard Gregory among the speakers. A discussion on " The Nature of Life " between General Smuts, Professor D'Arcy Thompson, Dr. J. S. Haldane and other famous scientists also took place during the last week.

The Hon. Henry Mond took part in a discussion on " Science and Industry " at Johannesburg, on August 1. A public lecture will be given by Professor A. S. Eddington, on " The Interior of a Star," at Pretoria, on August 9.

" Agriculture and the Empire " was dealt with by Sir Robert Greig, in his presidential address at Pretoria on August 1. Major Walker Elliot, M.P., taking part in the discussion.

Many of the papers are on matters of particular importance to the Union but with an Imperial significance. Sir Henry Maybury will give the weight of his knowledge on questions of road transport.

Sociological aspects of African life will be dealt with in such papers as: " The Mentality of the Poor White "; " Coloured Labour and Trade Unionism "; " The White and Coloured Populations "; " South African Tariffs "; and " Education and the Native Races."

Among other matters for discussion are: " Problems of Unemployment in Great Britain "; " The New Airship R 101 (a public lecture); Sir Charles Parsons on "Steam Turbines"; Dynamics and Sport";

GREAT CHEMISTS.

The discoveries and researches of to-day become to-morrow a part of the development and history of science. It has now come to be realised, especially during the last decade, that a search through the knowledge accumulated by the distinguished chemists and scientists of the past is of great value to the investigators of to-day. Whilst progress has been remarkably rapid in some directions, in others there has been little conspicuous advance for a long time.

Recently, in England a number of chemists have interested themselves in the history of their science and several important books have appeared upon various phases of the early development of chemical and allied sciences and notices of most of these have appeared from time to time in *The Chemical News*. In Germany, too, there has been activity in the same direction and a new and important work, *Das Buch der grossen Chemiker** is the first of two volumes to be published under the editorship of DR. GUNTHER BUGGE, and with the collaboration of several leading continental chemists who have made special studies of the men upon whom they write. To trace the development of the science from Zosimos (A.D. 350-420) to Schönbein (1799-1868) has occupied close upon 500 pages Zosimos of Panopolis was one of the earliest alchemists of whom record remains. His writings most probably reached the Arabians, who in the seventh, eighth and ninth centuries, energetically pursued the study of alchemy. The greatest chemist of Islam was the celebrated Jabir ibn Hayyan, whose discoveries and contributions to the development of chemistry have been so well described by Dr. E. J. Holmyard. Jabir's writings, together with those of Ibn Sina, Al-Razi and other Arabian alchemists, were translated into Latin. There were so many attributed to Jabir, or Geber, as he came to be styled, that it has been contended that a " Pseudo-Geber " flourished in the thirteenth century contemporaneously with Roger Bacon and Raymond Lully.

Dr Gunther Bugge's volume contains a lengthy account of the writings of one, Vannoccio Biringuccio (1480-1538?) by Prof. Johannsen, from which it would appear that this Italian alchemist made valuable contributions to the technical side of

* *Das Buch der grossen Chemiker.* Edited by DR. GUNTHER BUGGE. Vol. I. (Zosimos to Schönbein). Berlin: Verlag Chemie G.m.b.H. W10. 1929.

chemical arts. The great contributions to two different branches of chemistry made by Paracelsus and Agricola entitle them to rank among that great chemist of all time. Prof. Strunz' account of the life and scientific work of Paracelsus, if adding little to what was already known, still remains of special value as the compiler has confined himself to the chemical and medical aspects of Paracelsus' work. This alchemist and mystic died at an early age in Salzburg.

Agricola may be said to have laid the foundations of mineral chemistry by his study of ores and his elucidation of the nature of the sulphides and sulphates. The celebrated *Triumphal Chariot of Antimony* and other works ascribed to a sixteenth century Benedictine monk, " Basil Valentine," are discussed by Dr. Felix Fritz, who concludes that the publisher, Johann Tholde is not the author as had previously been suppposed.

After this period the progress of chemistry began to be more rapid. The discoveries of Glauber, the van Helmonts, Boyle and their contemporaries soon established chemistry and its applied sciences on the sure foundation of facts and reasoned theory. It is true that Stahl's Phlogiston Theory of combustion was advaneed at the close of the seventeenth century in spite of the known experimental evidence against it. But after a short set-back (marked none the less by continued experimentation) steady, if not remarkable, progress was made by the works of Black, Cavendish, Priestley and others in England and Marggraf, Scheele, Leblanc, Lavoisier, Berthelot and Klaproth, among others, on the continent. Finally, there comes the period from Proust and Dalton, to Faraday and Schönbein, embracing the work of not only of these but of their contemporaries, Gay-Lussac, Thènard, Davy, Berzelius and Mitscherlich. The rather meagre sketches of the life and work of Davy and of Faraday (only about ten pages each) have been written by Prof. Wilhelm Ostwald.

This important German compilation dealing with the great chemists from Zosimos to Schönbein is a valuable and welcome addition to the literature on the history of chemical science. Of its value a German reviewer has said :

" Die *Geschichte der Chemie* findet in letzter Zeit immer mehr Beachtung. Man bringt ihr nicht nur deshalb Interesse entgegen, weil die historische Entwicklung der Chemie noch reich an ungelösten Problemen ist, sondern auch deshalb, weil erst im Nacherleben des geschichtlichen Werdens der Chemie sich Sinn und Bedeutung dieser Wissenschaft will erschliessen. Für den zur Specialisierung gezwungenen Chemiker bedeutet Beschäftigung mit Chemiegeschichte noch dadurch einen weiteren inneren Gewinn, das sie dazu beiträgt, sein persönliches Verhältnis zu dem fast unübersehbar gewordenen grossen Reich der Wissenschaft zu vertiefen. Das jetzt von Dr. G. Bugge herausgegebene *Buch der grossen Chemiker* will im Sinne dieser Ausführungen für die Chemie und ihre Geschichte werben, indem es—wohl erstmalig in Deutschland—den biographischen Essay zur Grundlage eined Einführung in die Geschichte der Chemie macht. Hervorragende Mitarbeiter, von denen nur Ernst Darmstaedter, Eduard Färber, Ferdinand Henrich, B. Lepsius, Georg Lockemann, W. Ostwald, Julius Ruska, Franz Strunz genannt seien, bieten cine Garantie dafür, das hier eine wissenschaftlich einwandfreie Darstellung von Leben und Werk der grossen Chemiker aller Länder und Zeiten geboten wird. Der jetzt erschienene 1. Band des Werkes, dem noch in diesem Jahre ein abschliessender zweiter folgen wird, behandelt die Chemiker " Von Zosimos bis Schönbein," also etwa die Zeit der bis 1800 geborenen Forscher, darunter die grossen Gestalten des Mittelalters (Albertus Magnus, Raymundus Lullus, Paracelsus nsw.), die ersten ' angewandten ' Chemiker Biringuccio, Agricola und Glauber, Schöpfer wichtiger chemischer Theorien wie Stahl und Lavoisier, die klassischen englischen Forscher Black, Cavendish, Priestley, Dalton, Davy und Faraday, die Franzosen Geoffroy, Leblanc, Berthollet, Proust, Fourcroy und Vauquelin, Gay-Lussac und Thenard, den genialen Scheele, den universalen Schweden Berzelius und die vielseitigen Berliner Chemiker Klaproth und Mitscherlich.

Jeder Chemiker, möge er rein wissenschaftlich im Laboratorium forschen oder praktisch im Betriebe der Industrie arbeiten, wird das *Buch der grossen Chemiker* in Stunder der Musse mit Genuss lesen ! "

The concluding sketch is on the life and work of C. F. Schönbein, who was born in 1799, so that Dr. Bugge's second volume will deal with the great chemists of the nineteenth century. One almost feels that Schönbein (d. 1868) Mitscherlich (d. 1863) and Faraday (d. 1867) really belong to that epoch for all remained active into the second half of last century, whilst Berzelius and several others included in Volume I made most of their discoveries within a hundred ago.

J. G. F. Druce.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY.

June 26, 1929, Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communications were read :

The Geology of the District Around Abbey-Cwmhir (Radnorshire). By RICHARD OWEN ROBERTS, M.Sc. Communicated by Prof. W. J. Pugh, O.B.E., B.A., D.Sc., F.G.S.

This paper dealt with an area of about 30 square miles in North-Western Radnorshire, immediately east of the Rhayader district described by Dr. Herbert Lapworth. The rocks belong to the Bala, Valentian, and Wenlock Series.

The Geology of the Country Around Bodfean (South-Western Carnarvonshire.) By CHARLES ALFRED MATLEY, D.Sc., F.G.S., AND ALBERT HEARD, Ph.D., M.Sc., F.G.S.

The Authors described the geology of a tract of country, about 3½ miles long by 2 miles wide, between Nevin and Pwllheli, chiefly in the parish of Bodfean. It includes the prominent hill of Garn Bodfean (918 feet above O.D.) and a lesser hill, Moel y Penmaen. Most of the remaining ground is covered by drift.

The country can be divided into two belts with reference to the dominant east-north-easterly strike. The northern belt includes Garn Bodfean and the ground north of Bod-eilan Mill; the southern belt runs from Glan-y-gors to Penprys, through Bodfean Hall and Moel y Penmaen.

All the igneous rocks of the area are considered to be extrusive, with the possible exception of a basalt which may be a sill. A detailed account of the petrography is given, with several new chemical analyses.

The paper discussed the tectonics of the area, the Bodfean volcanic series of the southern belt being regarded as part of the volcanic series of Llanbedrog and Madryn brought up as a fold, and the Garn Bodfean Thrust being compared with the Penforma Thrust near Criccieth and the deformed thrust of St. Tudwal's Peninsula.

The Petrography of the Borrowdale Volcanic Series of the Kentmere Area (Westmorland). By GEORGE HOOLE MITCHELL, Ph.D., M.Sc., F.G.S.

In a previous communication the succession and structure of the Borrowdale Volcanic Series in Troutbeck, Kentmere, and Long Sleddale were described. The present paper forms the sequel, and deals with the petrography of the rocks of that area. The volcanic rocks are composed of both lava-flows and tuffs, and chemical analyses and microscopical examination show them to be of intermediate composition, varying from basic andesites to rhyolites. The rocks are greatly altered, and this has led to difficulty in distinguishing between lava-flows and tuff-deposits, particularly when the former are brecciated owing to flow. The characters of the lava-flows and tuff-deposits are discussed in detail.

The alteration of the rocks, as shown by the changes in mineral composition, together with the materials filling the vesicles, is considered. The conclusion is reached that much of the alteration may be referred to a variety of propylitization.

Lantern-slides were exhibited in illustration of the three papers read by Prof. Pugh, Dr. Matley, and Dr. Mitchell, respectively.

The Meeting was adjourned to Wednesday, October 23, at 5.30 p.m., for the purpose of reading the following papers :—

Historic Changes of Level in the Delta of the Rhone. By R. D. OLDHAM, F.R.S., F.G.S.

A Petalocrinus *Limestone in the Woolhope and Adjacent Districts.* By R. W. POCOCK, M.Sc., F.G.S.

The Carnmenellis Granite : Its Petrology, Metamorphism, and Tectonics. By P. K. GHOSH. Communicated by Prof. W. W. Watts, Sc.D., F.R.S., F.G.S.

Forthcoming Events.

THE INSTITUTE OF METALS.

The forthcoming Congress of metallurgists to be held in Düsseldorf from September 9-12 promises to be extraordinarily interesting. Already nearly 200 persons from all over Europe — and some from America—have indicated their intention to participate in the gathering.

The congress will comprise (a) the presentation and discussion of about 15 scientific and practical papers relating to metallurgical work; (b) visits to works in or near Düsseldorf and Berlin; (c) Receptions, dances and other social functions.

Persons who desire to participate in the congress should write for particulars without delay to the Secretary of the Institute of Metals, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

22,355.—Elektrochemische Ges., and Grohmann, H.—Manufacture of calcium nitride. July 20.

22,202.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of chromium oxide pigments, etc. July 19.

21,735.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of esters and amides of 2 : 3-amino naphthoic acid, etc. July 15.

22,017.—Karpati, J.—Effecting chemical reactions in the presence of materials activated by electrical energy. July 17.

21,912.—Schering-Kahlbaum Akt.-Ges. — Manufacture of menthane. July 16.

Specifications Published.

315,200.—Hooley, L. J., Thomas, J., and Scottish Dyes, Ltd.—Manufacture of derivatives of the benzene, naphthalene, and acenaphthene series.

315,330.—Coplans, M. — Preparation of stable medicinal salts of acetylsalicylic acid.

315,254.—Chwala, A. — Process for the mechanical dispersion of alkaline earth and heavy metal salts of the phosphoric and arsenic acids.

288,977.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of metal sulphates from sulphides and its application to gas-purification.

300,548.—Wacker Ges fur Elektrochemische Industrie Ges., D. A.—Manufacture of acetone from acetylation liquors.

Abstract Published.

312,908.—Hydrochloric and hydrobromic acids.—Rohm & Haas Akt.-Ges., 42, Weiterstadterstrasse, Darmstadt, Germany.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—SOUTH AFRICA, 1929.

THE RELATION OF ORGANIC CHEMISTRY TO BIOLOGY.

Address by PROFESSOR GEORGE BARGER, M.A., D.Sc., F.R.S., President of Section B (Chemistry). July 23, 1929.

Since the British Association first met in South Africa, Afrikaans has become an official language, and I will therefore take as my point of departure the Dutch word for chemistry, still commonly used in Holland: Scheikunde, the science of separating. The German analogue, "Scheidekunst," hardly applies to chemistry as a whole, and is now mainly restricted to the separation of gold and silver—"parting," as we say. Since the purification of a substance is merely the separation of impurities, and since purification constitutes no small part of the labours of the chemist, whether he be an inorganic, an organic, or a biochemist, it will be seen that the Dutch term is really apt; it is, moreover, an accurate description of chemical analysis; perhaps it will appeal least to those physical chemists who are content to leave the purification of their materials to the manufacturer. Since, in the last resort, we are dependent on naturally occurring materials, which hardly ever occur in a state of purity, it follows that the early chemists were even more concerned with separating one substance from another than many of us are to-day. Progress was at first limited to mineral substances capable of withstanding powerful reagents and a high temperature; much of the old chemistry is concerned with the heavy metals. The substances formed in such large numbers by living beings are much less stable, and their isolation demands a special technique. It is significant that, in spite of their knowledge of the smelting of ores, of the manufacture of glass, and of many other arts, the ancients failed to distil alcohol. Later the chemical investigation of organic material was apt to consist in destructive distillation, naturally adding little to knowledge. Only the more volatile and stable substances could be isolated in this fashion. Thus, in 1770, four acids were known, formic and acetic, obtained by distillation, succinic and benzoic, obtained by sublimation. Oxalates and tartrates were known, but not the free acids. By distilling alcohol with strong acids, ether, ethyl nitrate, and ethyl chloride had been obtained.[1] The wet method of separation, by crystallisation from solution, had scarcely been applied to organic substances. Nevertheless Marggraf of Berlin had isolated beet sugar in 1747; this chemist was also the first to purify glucose.

An important systematic advance was made by C. W. Scheele (1742-1786), whose contributions to organic chemistry are almost as important as his discovery of oxygen. Scheele was a pharmacist, and most of the early chemists were trained as such, or as physicians, from the iatro-chemical period onwards. This old connection between chemistry and medicine was, however, hardly a biological one. Joseph Black's work on fixed air and the mild alkalies indeed originated in medicine, from his M.D. dissertation, "De humore acido a cibis orta et magnesia alba," but the subsequent developments of Black's work were not biological in character. Again, although Berzelius was trained as a physician, his work had little connection with biology. The use of vegetable drugs, however, led pharmacists to examine the constitneuts of plants, and thus the foundations of descriptive biochemistry were laid. Scheele investigated a number of organic acids in the wet way. He obtained tartaric acid in 1769, and later benzoic acid by boiling gum benzoin with lime. He first prepared lactic acid (1780) from sour milk, and mucic acid by oxidation of milk sugar. When soon afterwards mucic acid was also obtained from gum tragacanth, it became evident that one and the same substance may be derived from both animal and vegetable sources. Oxalic acid was obtained from the acid potassium salt in *Oxalis acetosella*, and shown to be identical with an oxidation product of cane sugar. Scheele also obtained citric, malic, and even gallic acid by crystallisation from solution. Of more general biological interest is his discovery of uric acid, of glycerol and of hydrocyanic acid; the last (acidum berolinense) by heating potassium ferrocyanide with dilute sulphuric acid. Scheele's discovery that esterification is greatly furthered by the presence of mineral acids later became important in connection with catalysis, but theoretical speculations were foreign to his nature, and he was not greatly concerned with the essential character of acids. Such questions appealed more strongly to Lavoisier, who improved the nomenclature of organic acids and also investigated alco-

[1] I have taken these and some other details from Graebe's *Geschichte der organischen Chemie.*

holic fermentation, a biochemical process which early engaged the attention of chemists.

Of course both Scheele and Lavoisier benefited biology more by discovering and investigating oxygen than by their contributions to organic chemistry. These latter contributions already illustrate two trends in organic chemical research. There were those who, like Lavoisier, were attracted by theoretical questions. Such were Gay-Lussac, Bunsen, and Frankland, who investigated radicles; Dumas, Gerhardt, and Laurent, who evolved the theory of substitution and of types; Wurtz, Hofmann, and Williamson, the forerunners of Kekulé in establishing the theory of structure, which coon became the common ground of all organic synthesis.

A knowledge of structure gave a great impetus to organic synthesis, not only in the laboratory, for theoretical purposes, but also in the factory for practical uses; the manufacture of dyes, of synthetic drugs, of explosives became an important industry. The number of known carbon compounds grew at an enormous rate. In 1883 some 20,000 were registered in Richter's Lexicon, in 1899 74,000, in 1910 144,000, and the number now is probably not much short of a quarter of a million. More than half of these are derived from coal tar, and only a small proportion occur in animals and plants. Instead of being the chemistry of organised beings, organic chemistry became the chemistry of carbon compounds. Until the present century the proportion of chemists who, like Scheele, were interested in natural products steadily declined, and biology became of little interest to chemists as a whole, but physiologists have more and more realised the importance of chemistry for their subject and the intermediate subject of biochemistry has rapidly developed.

The systematic study of natural products, inaugurated by Scheele, was at first continued most successfully in France, by Fourcroy, Vauquelin, and their pupils. Both were at the Jardin des Plantes, and Vauquelin was afterwards at the Faculté de Médecine. Conjointly they discovered urea and hippuric acid, Vauquelin allantoin and asparagin. In 1800 about twenty acids were known, but only one hydrocarbon (ethylene) and one alcohol.

The knowledge of organic substances slowly increased. Braconnot, a pharmacist, and later director of the botanic garden at Nancy, examined plants and discovered substances such as salicin and ellagic acid, of no particular importance to physiology, but also obtained glucose from cellulose (linen) and "sucre de gélatine" or glycine from glue, thus making two fundamental observations in biochemistry. Kirchhoff, a German pharmacist, working at St. Petersburg, had already shown in 1811 that glucose is formed from starch, and investigated the process of malting. In 1833 Payen and Persoz discovered the first enzyme diastase and in 1827 a medical practitioner of London, W. Prout, better known to chemists in another connection, could say in a paper: "On the ultimate composition of simple alimentary substances" that they might be arranged in three classes, "the saccharine, the oily, and the albuminous."

Thus, quite early, pharmacists and physicians brought organis chemistry into close relation with biology, but further advance could not take place without the development of organic analysis, by Gay-Lussac and Thénard (1810), by Berzelius, Liebig, and others. At first the difficulties were enormous. In 1814 Berzelius wrote to Berthollet: "J'ai employé un travail de 12 mois à l'analyse de seulement 14 substances végétales." But by analysis Gay-Lussac was able to establish the fundamental equation for the fermentation of glucose into alcohol and carbon dioxide, and the first systematic advance in biochemistry, also due to analysis, was Chevreul's great work on the fats. Chevreul doubtless acquired an interest in natural substances from his teacher Vauquelin; he was attracted to the study of fats by the accidental crystallisation of a potassium soap from hydrolysed lard. He altogether isolated seven fatty acids and discovered cholesterol and cetyl alcohol. In his "Analyse organique," published in 1824, he already considered as contrary to the spirit of science the assumption that animal and vegetable substances could not be produced artificially. In that very year, 1824, Wöhler obtained oxalic acid from cyanogen, the first synthesis of a vital product, if we except Scheele's production of cyanides from carbon, potassium carbonate, and ammonium chloride. Four years later, in 1828, Wöhler's synthesis of urea attracted universal attention, and since then much labour has been expended on the synthesis of vital products as an ultimate proof of their structure.

Wöhler had apparently no connection with medicine or pharmacy, but Liebig was a pharmaceutical apprentice for one year, Frankland a druggists's assistant, Dumas, Schorlemmer, and even Wilhelmy, who in-

vestigated the kinetics of sugar hydrolysis, were pharmacists. Gmelin, Mitscherlich, Wurtz, and Cannizzaro studied medicine; even in the present century medically qualified professors of general chemistry survived (Crum Brown, Emerson Reynolds). The pharmacists soon found a special field of research in alkaloids, essential oils, and other products of the materia medica. Within a few years of the recognition of the first organic base, morphine, by the German pharmacist Sertürner, a dozen alkaloids had been discovered, mostly in France, by Pelletier and Caventou, professors at the Ecole de Pharmacie. It is presumably due to this institution, and to the high standard of pharmaceutical education in France that the scientific output of French pharmacists has been so long maintained. For recent times we may refer to Bourquelot, professor at the Ecole de Pharmacie, and to Charles and Georges Tanret, father and son, both practical pharmacists, who not only made important contributions to our knowledge of drugs but also to that of sugars. In Germany contributions of pharmacists to organic chemistry were of less importance, compared with the great developments in university research, inaugurated by Liebig and fostered by the German states. In Britain the state did very little for the universities and nothing for pharmaceutical teaching; although British pharmacists have the exclusive legal right to call themselves "chemists" the state has not helped them to justify the title. At first the British themselves contributed little to organic chemistry; of the pioneers Faraday, Frankland, Perkin, and Williamson, only two were teachers. The sojourn of Hofmann in London, from 1845-1865, from the age of twenty-seven to that of forty-seven, was of the greatest influeuce on the development of organic chemistry in England, but it did not lead to biological applications. Particularly through the inauguration of the dye industry, by Hofmann's pupil, Perkin, and Mansfield, attention was directed to practical problems. The determining factor in Hofmann's decision to return to Germany as professor at Berlin is stated to have been the more idealistic attitude towards science of German stndents, in contrast to the practical sense of his English pupils, who desired knowledge of a more utilitarian kind. Germany was not yet industrialised and the insistence on research in her universities favoured "Naturforschung" and the study of products of vegetable and animal origin. Characteristically Liebig's practical applications of chemistry to agriculture seem to have attracted more attention in Britain that in his own country. But in physiological chemistry German began to lead the way.

German organic chemists investigated not only substances such as alkaloids, colouring matters, and terpenes, which are mostly restricted to a few species, but systematically studied whole classes of biologically important compounds, in the same way as Chevreul had much earlier investigated the fats. Such was Baeyer's work on uric acid and its derivatives. Emil Fischer, after a short period of work on triphenylmethane, devoted the labours of a life time to the purines, the simpler carbohydrates, the proteins, and the tannins.

As a result of Fischer's work the new science of biochemistry was firmly established in the beginning of the present century, and the year 1906 marked its recognition in three countries, when three new journals first appeared: the *Biochemische Zeitschrift* in Germany, the *Biochemical Journal* in Britain, and the *Journal of Biological Chemistry* in America; the first named absorbed Hofmeister's *Beiträge zur chemischen Physiologie und Pathologie*, already a competitor of Hoppe-Seyler's *Zeitschrift*. The interest of German organic chemists in substances of general biological importance may be further illustrated by Willstätter's work on chlorophyll, carotin, the anthocyanins and enzymes, by Windaus' investigations on the sterols, by Wieland's work on the bile acids and by Hans Fischer's study of the porphyrins, which recently resulted in the synthesis of hæmin.

British organic chemists appear to be more interested in theoretical problems. I find that during the years 1927 and 1928 about 580 papers on organic chemistry were published by the Chemical Society, constituting much the largest portion of the Journal. Of these rather less than 20 per cent. may be said to deal with natural products and were inspired largely by W. H. Perkin (himself a pupil of Baeyer) and by Perkin's pupil, Robinson. About 45 per cent, of British papers on organic chemistry are more or less directly concerned with such theoretical questions as stereo-chemistry, the nature of valency, reactivity, tautomerism, and the remaining 35 per cent. deal with the synthesis of new compounds devoid of theoretical and biological interest, although occasionally having practical importance. German organic chemists seem to be more interested in natural products. I estimate that of the organic chemical papers

in the Berichte for 1928 about 40 per cent. are concerned directly or indirectly with such substances. It should not be supposed that organic chemical theory is wholly unconnected with biology. Two examples out of many will show the contrary. When a protein is "racemised" as far as possible, by Kossel's method, by leaving it for some weeks at 37° in half-normal alkali, it is found that certain aminoacids retain their optical activity, and these Dakin had assumed to be the ones with free carboxyl groups, situated at the ends of chains. The others undergo racemisation probably because in their case tautomerism is possible :

-CO.NH.CR′H.CO.NH.CR″.COOH
TWO ARROWS HERE One up, One down.
-CO.NH.CR′ :COH.NH.CR″H.COOH

On subsequent acid hydrolysis the amino-acid NH_2CR' :H.COOH would be racemic, but NH_2.CR″H.COOH optically active. Dakin's views were first applied by Dudley and Woodman to show a structural difference between the caseinogens from cow's milk and sheep's milk, which had been considered by some to be identical. Elementary analysis shows no difference and individual amino-acids are obtained in the same amounts after hydrolysis. After racemisation, however, Dudley and Woodman found the tyrosine from cow's caseinogen to be wholly inactive, that from the sheep fully active. In the former animal the tyrosine is probably inside the molecule, in the latter it is on the periphery. We are thus able to discover differences in the intimate pattern of the molecule. Dakin and Dale connected these differences with antigenic specificity. Crystallised albumins from the whites of hens' and ducks' eggs are very similar and seem to be composed of the same units in equal amounts, but Dakin found that three amino-acids, leucine, aspartic acid, and histidine, behave differently to alkali in the two molecules, and appear to occupy different places. Hen's albumin has some aspartic acid but no leucine or histidine on the periphery; duck's albumin, on the other hand, has no aspartic acid, but some leucine and histidine on the outside of the molecule. By the very sensitive anaphylactic reaction of the isolated guinea pig's uterus, Dale showed that the two proteins are specifically different as antigens. Differences in arrangement, even of the same amino-acids, help to differentiate the proteins of various species. It is on the diversity of the proteins that the difference of species is based.

Another recent example of the application of organic chemical theory to biology is due to Stedman. Having traced the miotic action of physostigmine to a urethane grouping, he synthesised a number of urethanes of simple dimethylamino phenols, *e.g.* R.NH.CO.O.C_6H_4.$N(CH_3)_2$. The physiological activities of the tertiary bases is generally in the order ortho and para>meta, but on conversion into quarternary salts the ortho and para becomes less active, the meta more so and the order is meta>ortho or para. This recalls the reactivities of disubstituted benzene derivatives, which have of late been studied in connection with the polarity theory.

(To be continued.)

AFRICA AND SCIENCE.

Address by JAN H. HOFMEYER, M.A.,

President of the South African Association, on the occasion of the Inaugural Meeting in Cape Town, July 22, 1929.

(Continued from page 72.)

I pass on to Medical Science. I have referred already to the contributions as to the study of the problems of industrial medicine and hygiene which the special circumstances of the South African gold mining industry have made possible. Those contributions have, we may well hope, but prepared the way for advances of a revolutionary character in the early detection, prevention, and treatment of all forms of respiratory disease. But even greater are the opportunities which the continent of Africa offers for the study of tropical diseases, of which it may well be described as the homeland. In Africa there have been and necessarily must be studied the problems connected with malaria, blackwater fever, sleeping sickness, yellow fever, and many other scourges of civilisation, and from Africa there may well come hope and healing for mankind. There are other problems of Medical Science for the study of which Africa is uniquely fitted. There are the physiological questions, important also from the political point of view, which bear on the fitness of the white races to maintain a healthy existence in tropical surroundings, at high altitudes, and in excessive sunlight. For these investigations the diversity of conditions prevailing in the various regions of the African continent make it a magnificent natural laboratory. There is the elucidation of the factors which account for the varying susceptibility of

white and coloured races to acute infectious diseases, tuberculosis, and certain types of malignant disease, together with the light which such elucidation may throw on the physical and chemical composition of the human body. Lastly, I would mention the exploration of that most interesting borderland between Psychiatry and Psychological Science by an analysis of the mentality of the diverse African peoples. That investigation has an important bearing not only on the limitations and capacities of racial intelligence, but also on the methods which the ruling races in Africa should follow in seeking to discharge their obligations towards their uncivilised and unenlightened fellow-Africans.

Closely linked with Medical Science is the study of Animal Biology. In some instances the problems of the two branches of Science are to be approached along parallel lines; in others biological investigations are fundamental to the growth of Medical Science; of no less significance is that unity which there is in nature, making it possible for the truths of Animal Biology to be translated into facts concerning mankind. In the African continent there is no lack of opportunity to advance Science by physiological inquiries into animal structure, by the isolation of the parasites of human and animal diseases, and by the tracing of the life histories more especially of the minuter forms of animal life. "Nowadays," in the words of Professor J. A. Thomson, "the serpent that bites man's heel is in nine cases out of ten microscopic." But scarcely less important are the extensive facilities which Africa still offers for the study of the habits and behaviour of the larger mammals. The naturalistic study of these animals, not as stuffed museum species, but in the laboratories of their native environment, has received all too scanty attention from the scientist, and this is a reproach which African Science, with its rich dowry of mammal and primate material, may confidently be expected to remove. Nor will this study of animal behaviour, especially of those animals which approach nearest to the human type, be without its bearings on our investigations of the workings of the human mind. If in this hasty survey I may take time to mention one more point within this field, I would refer to the results which await the intensified activity of the marine biologist and the oceanographer in the as yet all but virgin territory of the African coast line. This Association of ours has long dreamed of an African Marine Biological Station as broad in its conception and comparably as useful from the wider scientifi and the more narrowly economic points of view as those of Plymouth or Naples or Woods Hole, and withal a rallying point for the naturalist, the zoologist, the botanist, the geographer, the anatomist, the physiologist, indeed for all those workers whose divers problems meet at the margin of the sea.

From Animal Biology we pass by an easy transition to Anthropology, the study of man himself. And here Africa seems full of splendid promise of discovery that may verify Darwin's belief in the probability that somewhere in this land-mass was the scene of nature's greatest creative effort. It would seem to be not without significance that Africa possesses in the chimpanzee and the gorilla those primate types which approach most nearly the form and structure of primitive man. To that must be added that in the Bushman, Pygmy, and negroid races Africa has at least two and possibly three early human stocks which are characteristically her own and belong to no other continent. No less striking is the fact that in Gibraltar, in Malta, and in Palestine, that is, at each and every one of the three portals into Africa from Europe and Asia in Pleistocene times, there have been discovered evidences of the presence of Neanderthal man. In Africa itself there was found at Broken Hill some nine years ago a skull with the most primitive or bestial facial form yet seen ,and so closely akin to the Neanderthal stock as to establish firmly the expectation of finding further compelling evidence of a long continued Neanderthaloid occupation of the African continent. The discovery at Taungs on the one hand, which reaches out towards the unknown past, and the finds at Boskop and in the Tsitsikama on the other, which assist in linking up the period of Rhodesian man with the coming of the bushfolk, open up to us, in conjunction with the aforementioned facts, a vista of anthropological continuity in Africa such as no other continent can offer. The recent investigations in the Great Rift Valley, near Elementeita in Kenya, and the fossil discoveries on the Springbok Flats, north of Pretoria, have again fixed the attention of the anthropologist on Africa.

Nor are the data presently available restricted to these discoveries. The efforts of archæologists, and the application of improved scientific methods in excavation, are giving us stratigraphical evidence of the succession of stone cultures which is of the ut-

most importance. I have already mentioned the assistance which Geolo--- can render in this work, but there is needed also the co-operation of those who labour in the converging fields of Anatomy, Archæology, Palæontology, and Comparative Zoology. That co-operation has already commenced. In the investigation of the Vaal River gravels it has yielded important results, and we may look forward to its continuance and expansion in the years that lie ahead. Of the importance of African Anthropology for the understanding of that of Europe there can be no question. Work of importance has already been done in the study of the relations between Palæolithic Art in Europe and Palæolithic Art in Africa. The significance of these comparisons is but emblematic of the importance of similar investigations in regard to stone cultures, rock engravings, ancient mining, stone circles and ancient ruins, methods of primitive mining and agriculture, tribal organisation, laws and customs, indeed the whole range of the hitherto unexplained or partially explained phenomena of living and extinct cultures. There is no lack of avenues which the student of African Anthropology may follow in the hope of finding at the end of them results of supreme value for Science in general.

I would speak next of the vast field, as yet almost uncharted, of phonological and philological study. Here in Africa we have great opportunities for the examination of linguistic problems, and some of them have bearings which extend far beyond the limits of Africa. One thinks first of the oportunities which Africa offers for investigating the results of the transplantation of languages, which have a long history of cultural development behind them, to regions inhabited by primitive peoples. Here there are two sets of phenomena, each with its own special interest. On the one hand we have the modification of the languages of those European peoples, who have established themselves in Africa as permanent settled communities, under pressure of the new linguistic influences into contact with which they have been brought. Of these phenomena the study of Afrikaans offers perhaps the best examples to be found in the whole field of linguistics—its importance for the student of comparative philology is very far from being adequately appreciated. On the other hand we have those cases where European languages have come to Africa as the languages not of settled communities, but of officials and others like them who are but temporarily domiciled in this continent, and leave no descendants behind them to carry on the process of evolution of distinctive forms of speech. Here the phenomena which are of interest to the students of linguistics are to be found in the wealth of deformation and adaptation which the native populations have introduced in their endeavours to speak the European languages of their rulers. Work such as has been done by Schucharde in Negro-Portuguese and Negro-French opens up a wide area of most attractive investigation.

But the most important task in the field of African linguistics is the actual recording of the native languages of Africa, our backwardness in respect of which is a reproach to Science. Such study is, of course, important in relation to Africa itself, but of even greater significance for my present purpose is its bearing on scientific problems of wider scope. In that connection I would suggest two points. We are still only at the beginning of the study of Comparative Bantu. That in due course should lead to a knowledge of Ur-Bantu. Such a study and such a knowledge will necessarily be of importance to the comparative philologist, both because of the light shed by the study of one group of languages on the study of otser groups, and also because it opens the way to the investigation of the relationship of Bantu to the other African tongues, and its place in the general scheme of the languages of the world. But of even greater interest is the study of African languages as throwing light on the inter-penetrations and interactions of primitive peoples. Language is a function of social relationship, and its study is therefore of great value for ethnological and historical investigations. May I give one instance of what I have in mind? Two millennia back South-West Arabia was the seat of the powerful commercial civilisations of the Mineans, the Sabæans, and the Himyarites, radiating eastwards to India and south-westwards to Africa. The extent of their relationship with Africa it has hitherto been most difficult to trace, but linguistic evidence may prove to be of great value. Professor Maingard has pointed out to me that the Makaranga who live near Zimbabwe call water "Bahri," a word closely related in form to "Bahr," the "sea" of the Arabs, although the Makaranga themselves are not a sea-board people, and that "Shava" is their word for "to sell or barter," while to the Himyarites "Saba" meant "to travel for a commercial purpose." Not less suggestive is the study of place-names, and while I do not suggest that I have evidence on which any

conclusion can be based, I do contend that these investigations may prove to be of a most fruitful character. It would be interesting indeed to see what evidence linguistics can bring in respect of the relationship of South Africa with Madagascar, and also with Polynesia through Madagascar, where the tribe once dominant politically, the copper-coloured Hova, are ethnologically and linguistically Melanesians amid the darker-hued Sakalavas and other negroid tribes. It may even be that such studies will conjure up to our minds pictures of great migratory movements with Arab dhows and South Sea praos cleaving the waters of the Indian Ocean. Only last year a canoe constructed of wood native to South-Eastern Asia was found in Algoa Bay.

And, finally, in this survey of what Africa can give to Science I would refer, with the utmost brevity perforce, to Africa as a field, favoured as is no other, for the study of all those complicated problems which arise from the contact of races of different colours and at diverse stages of civilisation. Of those problems, ranging from the investigations of the biological factors involved in the conception of race to the practical problems of the administration of backward peoples I need not speak. They have come to be part almost of the every-day thinking of most civilised men. What I would emphasise is that in Africa, as nowhere else, the factors which constitute these problems can be studied both in isolation and in varying degrees of complexity of inter-relationship, that in Africa we have a great laboratory in which to-day there are going on before our eyes experiments which put to the test diverse social and political theories as to the relations between white and coloured races, that in Africa there are racial problems which demand solution, and the solution of which will affect or determine the handling of similar problems throughout the world. We hear men speak of the clash of colour, and are sometimes told that Africa is the strategic point in that struggle. I think of it rather as the continent which offers the richest opportunities to those who would investigate racial problems in the true spirit of Science, and so discover the solutions, which may yet enable that clash to be averted and the threat which it implies to our civilisation to be dispelled.

I have sought—briefly and all too inadequately—to indicate some of the lines along which Africa seems to be able to make a distinctive contribution to Science. It remains for me, yet more briefly, to speak of Africa's challenge to Science, and to seek to answer the question, What can Science give to Africa? I shall not stop to emphasise the point, that the greatness of Africa's potential contributions to Science, the key which perhaps she holds to the riddle of human origins, the intriguing vistas opened up in the study of her relationship with South America and Australasia with its suggestion of past continental continuity, that all these and more constitute a challenge to Science to actualise those potentialities. Let me seek rather to define the two-fold challenge of Africa in another way. Firstly, Africa defies Science to unravel her past. Throughout history she has ever been the continent of mystery. She was so to that pioneer of geographers, Herodotus, to whom nothing that was told him about Africa was so improbable that he declined to give it credence. She was so to the Romans, who regarded Africa as the natural home and source of what was strange and novel and unaccustomed. She was so to the navigators who did so much to break down the barrier wall between the Middle Ages and the Modern World. And though in our day the geographical mysteries of Africa have in large measure been solved, the work of the prober of her scientific secrets is only beginning. Then, secondly, Africa challenges Science to define, to determine, and to guide her future. If the great resources of this vast undeveloped continent are to be made available for humanity in our own and the succeeding generations, Science must make it possible for the man of European race to undertake that work of development, by showing him how to protect himself, his stock, and his crops against disease, by enabling him to conserve and utilise to the greatest extent the soils, the vegetation, and the water supplies of the continent, by bringing to bear the resources of modern engineering on the exploitation of its wealth, and not least by determining the lines along which white and coloured races can best live together in harmony and to their common advantage.

That is the challenge of Africa to civilisation and to Science. It is not now thrown out for the first time; it is not the first time that it will have been taken up. It is in Africa that the Greco-Roman civilisation won some of its most glorious triumphs, in Africa that the spade of the archæologist has in our day, by uncovering great Roman towns with noble public buildings and efficient irrigation systems, provided impressive evidence of the magnitude of the

achievement of Roman Imperialism. But Rome failed to conquer Africa for civilisation, and left the challenge to those who were to follow after. She failed chiefly for two reasons; the might of African barbarism and the defiant resistance of African nature. We in our day, confronted by the same challenge, still have the same enemies, hitherto victorious, to contend against. But we meet them with the advantage of having resources at our disposal which our Roman predecessors lacked. It is to use those resources effectively that Africa challenges Science.

In dealing with African barbarism we have weapons such as Rome could never dream of, and not the least valuable are those provided by the scientific investigation of the native peoples of Africa. The way to the solution of the problems presented by African barbarism is to be sought in an understanding of the character and mentality of primitive peoples, in the exploration of those regions in their social life where are to be found the factors that determine their reaction to diverse methods of administration. The study of African languages and of African Anthropology is therefore fundamental to the development of the continent. For that work Africa possesses special advantages, and one can but hope that the facilities now being built up in our South African Universities will be recognised in Britain and elsewhere, and become an important factor in the response of Science to the challenge of Africa.

Not less formidable is the conquest of African nature, for the achievement of which also we in our day are far better placed than were the Romans. It is modern Science which gives us that advantage. Three great tasks confront Science in the conquest of African nature. First, Science must make Africa safe for the white man to live in. I have spoken of the opportunities which Africa offers for the study of tropical diseases as likely to yield results of significance for Science in general. But primarily will those results be of significance for the development of Africa? This part of the challenge of Africa is not lightly to be taken up. Africa has taken heavy toll of Science. The recent deaths in Nigeria of Stokes, Young, and Noguchi, worthy followers in the tradition of Lazear and Myers, are a reaffirmation of the gravity and insistence of that challenge. The importance for the cause of civilisation of a successful response to that challenge cannot be illustrated better than by the story of the construction of the Panama Canal. De Lesseps attempted the task and failed. For every cubic yard of earth excavated by him a human life was sacrificed to yellow fever or malaria. It was the successful attack some twenty years later on the death-dealing mosquito under the direction of General Gorgas that made possible the completion of one of the most important engineering enterprises of modern times.

Secondly, Science must combat the foes which have to be contended with in the development of African agriculture. Africa is prodigal indeed in the production of insect and other foes to cattle and to crops. Science is already making an effective response to this part of the challenge. But there is much that remains to be done. And we shall be none the worse for the timely realisation by the politician and the administrator of the contributions which Science can make. All too often in the past settlement schemes have been undertaken and ended in disaster in areas unhealthy to man, beast, or crops, when, if the scientist had first been called in, precautions might have been taken which would have averted the calamity.

Finally, Science must harness the great resources of Africa. And here there are suggested to us all the varied contributions which the engineer can make in the work of development. Has not the Institution of Civil Engineers defined the ideal underlying all engineering activity as "the art of directing the great sources of power in nature for the use and convenience of man"? Africa offers abundance of opportunities for the realisation of that ideal. It is not by working in isolation that the engineer will realise it, but rather by co-operation with his colleagues in other branches of Science, and by the correlation and co-ordination of the essential data which they must do so much to provide. First in the order of engineering development come the civil and mining engineers. Their tasks are the provision of facilities for communication, for health, for the conservation of agricultural assets, for the production of raw material, and for the development of mineral resources. In their train there follow, with the advent of industrial activity, the mechanical and electrical engineers. Their tasks are to make the fullest use of the revolution in ideas of transport, including transport by air, which have resulted from the perfecting of the internal combustion engine, and to secure the maximum advantage possible from cheap production and efficient distribution of electrical power. The day must

come, to give a concrete instance, when the Victoria Falls, with their immense water resources, will mean much more for Africa than Niagara to-day means for America. Later still there will be called in the services of the chemical engineer, ever engaged in problems of research, to ascertain the most advantageous processes of converting raw materials into manufactured articles. In all these tasks it is the South African engineer who has, under the conditions of an undeveloped land, built up a technique and practice suitable to African requirements and showing promise of wider applicability, that we may well expect to assume a position of leadership and of inspiration. These are some of the ways in which Science can respond to the challenge of Africa.

The picture which I set out to portray I have now completed. I have tried to suggest something of the magnitude of the rewards which Africa has in store for the scientist who has the enterprise to adventure and the vision to see. I have sought also to be the medium of the challenge presented to Science by Africa's opportunities and needs. It is a vast canvas on which I have had to work. On it I have drawn but a few sketchy outlines. Yet I hope that the vision stands out clear. I hope that I have said enough to convey the power of its inspiration. Not least do I hope that you, our visitors, will play a great part, in the time that you will spend with us, in filling in some of the details of the picture, and in quickening and vitalising its message for the scientists of South Africa. It is to them chiefly that it makes its appeal. The development of Science in Africa, of Africa by Science, that is the promised land that beckons them. I believe that they will not be disobedient to the vision.

BORON HYDRIDES.

From a study of boron hydrides E. Wiborg concludes (*Zeitschr. anorg. Chemie*, 1928, CLXXIII, 199), that boron is trivalent in all electrovalent compounds but becomes pentavalent in co-valency compounds. Quadrivalent boron is non-existent. This is shown to be consistent with the addition of ammonia to boron hydride, with its behaviour with water and acids and the formation of hypoborates.

Last year the copper output of the Union Minière du Haut Katanga was 112,000 tons. During the first six months of this year 64,000 tons have been produced.

THE PRESIDENTIAL ADDRESS.

THE

INTERNATIONAL RELATIONSHIP OF MINERALS.

By SIR THOMAS HOLLAND, K.C.S.I., K.C.I.E., LL.D., D.Sc., F.R.S., *President of the Association.*

(*Continued from page 69.*)

I have elsewhere[1] made estimates of the quantities of metals stored in that part of the outer film of the earth's crust which may be regarded as reasonably accessible to the miner. The actual figures in billions of tons convey no precise mental impression to us, and need not be quoted here, but certain of the outstanding conclusions have a bearing on our present line of argument.

The first feature of surprising interest to the man in the street is perhaps the relative abundance of those metals with which he is familiar in the Arts—copper, lead, tin, zinc and nickel. Nickel, in spite of its price and limited use, is twice as abundant as copper, five times as abundant as zinc, ten times as abundant as lead, and from fifty to one hundred times as abundant as tin. There are, indeed, among the so-called rare metals some which are distinctly more abundant than lead, although this is the cheapest of the lot in price, and is consumed at the rate of over a million tons a year.

And so one gets at once an indication of two important features. Firstly, the miner works only those deposits in which the metal is concentrated sufficiently to make their exploitation a profitable business; and secondly, the metalliferous ores vary greatly in the completeness with which they have been concentrated in special places to form workable ore-deposits. Nickel-ore, for instance, occurs under conditions which conspicuously hinder its freedom of local concentration; and consequently the wide distribution of the metal and its relative abundance bring little comfort to those who are anxious about their supplies of a metal which jumps suddenly into importance with every rumour of war. We are safe in predicting that we shall never recover for use in the Arts any fraction of our total supplies of nickel as large as we shall of most of the others which have been mentioned. Indeed, nickel stands apart from the others; for, whilst it is important in peace time and is

[1] Presidential Address, Institution of Mining and Metallurgy, *Trans.*, Vol. xxxiv, 1925, p. lvii.

dangerously important during war, yet, under the present state of mining and metallurgical practice, the deposits in the world worth working for nickel can be numbered on the fingers of one hand, and nine-tenths of our spuulies come from a single district in Canada.

Before discussing more precisely the significance of this and similar facts on the question of international relationships, let us consider for a moment the nature of our exploitation methods. Our reference to nickel shows that the metalliferous ores vary in their degrees of concentration, and therefore, in their suitability for working; but, as the result of estimates made for a few common metals, we shall not be far from the average in assuming that we shall never recover more than about one-millionth of the total that lies within workable distance from the surface of our accessible dry land. And another conclusion, based on a similar group of calculations, shows that our greatest total tonnages are not contained in the rich deposits, but in those of low-grade.

It follows, therefore, that every advance in metallurgical science and in mining technology that makes it possible to work our low-grade ores adds appreciably to the actuarial value of civilisation; for our mineral resources can be worked once and once only in the history of the World, and when our supplies of metalliferous ores approach exhaustion, civilisation such as we have now developed during the last century must come to an end. When a miner raises a supply of ore in concentrated form for the metallurgist, he damages, and so places beyond reach for ever, far larger quantities of residual ore than he makes available for use. When a metallurgist takes over the product of the miner and separates the refined metal for use in the Arts, he also incurs serious losses, although not to the same extent. There are thus before both the miner and the metallurgist opportunities for extending the actuarial value of civilisation; and because the cost of labour is the principal constituent in the total bill, and has recently swamped contemporaneous advances in technology, the gradual elimination of manual labour by mechanisation is obviously the most profitable line of research.

But mechanisation carries with it in general a tendency to limit operations to the larger deposits, with the concurrent neglect of those propositions which are widely scattered over the earth, and, though individually small, represent in the aggregate a serious section of our limited resources. And so our operations in mining, with the family of industries dependent on minerals, tend more and more to be restricted to a few special regions, where work can be done on a large scale.

So now, with this thumb-nail sketch of the way in which the new mineral era is developing, we are free to examine more closely the influence which this change in the configuration of the industrial world is likely to have on intrnational relationships.

In the first place, it becomes obvious that no single country, not even the United States, is self-contained, whether for the requirements of peace or for the necessities of war. Not even the more scattered sections of the Earth that are politically united to form the British Empire contain the full variety of those minerals that are the essential raw materials of our established activities.[2] Between them these two—the British Empire and the United States — produce over two-thirds of the 2,000 million tons of mineral that the world now consumes an-

[2] For purposes of reference I give a list of minerals, showing how the resources of the British Empire, so far as our present information goes, can be relied on. This list has been kindly revised by Mr. T. Crook of the Imperial Institute.

1. *Those for which the World now depends mainly on the Empire*—Asbestos, china clay, chromite, diamonds, gold, mica, monazite, nickel and strontium.

2. *Those of which we have enough and to spare*—Arsenic, cadmium, cobalt coal, fluorspar, fuller's earth, graphite, gypsum, lead, manganese, salt, silver, tin and zinc.

3. *Those in which we could be self-contained if necessary* — Bauxite, barium minerals, felspar, iron ore, magnesite, molybdenum, platinum, talc, tungsten and vanadium.

4. *Those for which we are now dependent on outside sources*—Antimony, bismuth, borates, copper, petroleum, phosphates, potash, pyrites, quicksilver, sulphur and radium.

A corresponding list for the United States was prepared in 1925 by a Committee under the chairmanship of Prof. C. K. Leith, and published under the joint authority of the two Mining and Metallurgical Institutions in New York.

nually. Each of them has more than it wants of some minerals; but, in order to obtain its own requirements at economic rates, each finds it necessary to sell its surplus output to other nations. Each produces less than it wants of some minerals, and so must obtain supplies from other nations to keep its industries alive. Each of them is practically devoid of a few but not always the same minerals, which, though relatively small in quantity, are none the less essential links in the chain of industrial operations. Even if these two could 'pool' their resources they would still be compelled to obtain from other nations the residual few. For it is important to remember that, unlike organic substance, it is not possible to make synthetic metals, and it never will be; it is not even possible to make artificial substitutes for many essential minerals that are used as such and not merely for their metallic constituents. There is no other mineral and no artificial substance for instance that can combine the qualities which give to the mineral mica its position of importance in the Arts—its fissility in thin sheets, its transparency to light and opacity to heat rays, its stability at high temperatures, its toughness and the degree of its insulating properties. There will never be a synthetic mica.

Thus the international exchange of minerals is an inevitable consequence of our new civilisation; and the cry for freedom of movement, for the 'open door' and for equal opportunity for development comes into conflict with the unqualified formula of 'self-determination.' Whatever may have been possible before the industrial revolution, when the mineral industry merely contributed to the simple wants of agriculture, when most national units were self-contained, the formula of 'self-determination' has come too late in the World's history to do good without a more than consequent amount of harm. We cannot even live now without the free interchange of our minerals for those of other nations; in the name of civilisation we dare not go to war.

There is one more group of fundamental data to recall before we are in a position to point the practical lessons which follow from the newly established and prospective mineral situation. I have already referred to the way in which economic considerations tend, through large-scale production, to restrict operations to a limited number of specially favoured areas. There was a time within my memory when the primitive *lohar*, a survival of the aboriginal inhabitants of India, could be found in every province, nearly every district. He collected the granular mineral from the weathered outcrops of relatively lean iron-ore bodies, and, by using charcoal as a fuel, turned out blooms of malleable iron in a miniature clay furnace, using a pair of goat skins to produce the necessary blast. These primitive workers also produced small ingots of steel by the carbonisation of wrought iron in clay crucibles many centuries before the same process made Sheffield famous.

But with the large-scale production of steel in western countries, attended by the opening of the Suez Canal, cheaper transport by steamers and the spread of railways from the coast of India, the *lohar* has been exterminated from all but the most remote parts of the country. His history is similar to that of other workers; the small orebodies that he used are of no interest to the modern iron-master, and one result therefore of the modern movement is the neglect of a large fraction of our total resources. We are discussing, however, what is actually happening, not what we think should be a less wasteful course of evolution; natural evolution, like 'trial and error' methods, is always wasteful.

Primitive workers in various lands have opened up to relatively shallow depths rich but small deposits of other ores, and in Eastern countries especially, where forms of civilisation extend far back into history, the numerous and widespread 'old workings' have given rise to travellers' impressions of great mineral wealth. But low-grade deposits that the ancient miner could not utilise are now opened up by mechanical methods on a large scale; and, on the other hand, what satisfied the primitive metallurgist in abundance would be of little use to the modern furnace.

We have now to revalue the tales of travellers which have had a dangerous influence on those who have directed the course of international competition; we have to strike out of consideration the integers of the primitive worker to whom a great tonnage would form a mere decimal point in the modern unit; we have to realise that our mid-Victorian standards of metal production are gone for ever, and that the comforting after-war formula of 'back to normal' is merely a hypnotic drug to conceal the uncomfortable, one might say regrettable, dynamic conditions which have since developed at a speed that is not sufficiently recognised within our Empire.

It is now misleading to speak of the wide distribution of minerals within a country as we could have done some fifteen years ago; we must now rule out the smaller deposits, and so form a new picture composed of those concentrations that are on a scale sufficient to support modern metallurgical units.

For this reason it is necessary to review afresh the resources of the undeveloped Far East, which has for many years been regarded as a menace to Western industrial dominance. The vague general notion that mineral deposits are evenly distributed throughout the Earth's crust has fed the impression that the development of China, which is much larger than the United States, may yet shift the centre of industrial gravity when integrations are stretching across political boundary-lines; and the demand for the interchange of mineral products will be satisfied in spite of fiscal barriers.

It would have been a shock to our members if, before the war, political problems were discussed from this Chair, and party politics may always be inconsistent with the mental products of culture. But the results of science and technology now limit the effects of national ambitions, and therefore dominate the international political atmosphere for good or evil. One is justified always in suggesting non-controversial measures that tend to good; and this it is proposed to do very briefly as the direct suggestion of the new configuration of the mining and metallurgical world.

The League of Nations has accomplished a large measure of international understanding in questions of social value; its influence in forestalling possible causes of war has raised new hopes; but fortunately, so far, it has not been compelled to use any such instrument of force as a blockade, and any such measure that clashed with the vital economic considerations of first-class powers would probably cause stresses well beyond its elastic limits. The more recent and simpler pact of Paris associated with the name of Mr. F. B. Kellogg wants equally an ultimate instrument for its practical enforcement.

It was with this ultimate ob ect in mind that the outline of my argument was drafted last year; but I am glad to find that my views have since been expressed independently. Senator Capper, of Kansas, in February last submitted a resolution to the merican Legislature recognising this shortcoming of the simple treaty, and proposing to supplement its moral obligations by a corollary which, if passed, will empower the Government on behalf of the United States to refuse munitions to any nation that breaks the multilateral treaty for the renunciation of war.

Senator Capper's resolution, however, still leaves unsolved a residual problem of practical importance. Those of us who had the painful duty of deciding between civil and military necessities in the Great War, know well that there is now but little real difference between the materials required to maintain an army on a war footing and those that are essential to the necessary activities of the civilian population; *materials* essential for one purpose can be converted to *articles* required for the other. Thus, if Senator Capper's resolution be adopted by those who have signed the Kellogg Treaty, either sympathy for the civil population would be stirred, or the armies would be still supplied with many essential munitions; the definition of "conditional contraband" would still remain as a cause for international friction.

A formula, still simpler but equally effective, is indicated by this review of the new situation arising from the essential use of minerals. It is suggested, therefore, as an amendment to Senator Capper's resolution, that the simple words 'mineral products' be substitute for 'arms, munitions, implements of war or other articles for use in war.'

The only two nations that can fight for long on their own natural resources are the British Empire and the United States. If they agree in refusing to export mineral products to those countries that infringe the Kellog Pact, no war can last very long. As our friends across the Atlantic have recently learn, it is easier to stop exports than to prevent imports: the Customs' officer is more effective, less expensive and far less dangerous than a blockading fleet.

The confederation of American States has the advantage of forming a compact geographical unit, without inter-State fiscal barriers to hamper the interchange of mineral products. The British Empire, in the words of Principal Nicholas Murray Butler, 'has passed by natural and splendid evolution into the British Commonwealth of Nations'; it is composed of geographically scattered and independent political units, among which freedom of interchange, with due regard to local interests, can be effected safely only by more complete knowledge of our resources. Next year the Empire Congress of Mining and Metallurgy will meet in

this city to discuss the proposition which I submitted to it at Montreal in 1927; and this Address must be regarded, therefore, as an introduction to a movement which one hopes will supply the necessary data, and *so facilitate a working agreement between* the two great Mineral Powers that alone have the avowed desire and the ability to ensure the peace of the world.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

The Thirteenth Annual General Meeting of the Association of British Chemical Manufacturers was held at the Chemical Society's Rooms, Burlington House, Piccadilly, London, W.1., on Thursday, 18 July, 1929.

Reports and Accounts.

The Chairman (Dr. G. C. Clayton, C.B.E.) in moving the adoption of the Report, said :

You have all had a copy of the Annual Report, so I shall go through it quickly, paragraph by paragraph, confining my comments to those items which are of special importance. The report, as you all know, is merely a résumé of the more important matters with which the Council has had to deal during the year, and is in no sense an exhaustive account of the work of the Association. Speaking generally, the past year has been notable for several new lines of activity which should prove of value to members, while the volume of work has increased considerably.

The membership shows a slight falling off in numbers due to unavoidable causes, but this gives no reason for anxiety. We feel, however, that it is advisable to attempt to secure as members all British Chemical firms of importance, because the more completely representative the Association is of the industry, the greater will be its power to make representations to the Government, and the more extensive can be its activities. We are therefore making active endeavours to secure fresh members, and we hope that every member will do what he can to help in this direction.

The Association has to mourn the loss of Sir John Brunner, and Mr. W. H. Dawson who have long served it faithfully and well and who, in their respective spheres, have played a very important part in the development of our chemical industry (hear, hear). The Report indicates the position in regard to the consequent vacancies on the Council.

Further staff changes have occurred as you will see from the report, but we hope that we are now commencing a period which will be free from such disturbing influences. We are glad to have to record the appointment of our General Manager to the Secretaryship of the three Associations mentioned in the report and to the Chemical Warfare Committee of the War Office. His appointment as Chairman of the Chemical Sub-Committee of that body will form a useful link between the chemical industry and the fighting services. I think we should like to congratulate our General Manager.

To turn now to the Directory, you will see that the 1929 issue, which is in many respects an improvement on its predecessors, has received a much wider distribution than previous issues. The Council felt that the work in preparing the issue was so great and the value of the book in advertising British Chemicals so well established, that it would be false economy not to give it the widest possible circulation. The Directory is, as you know, in six languages, namely, English, French, German, Italian, Spanish and Portugese, and is therefore an admirable publication for world wide distribution, a point which has, I might interpolate, been appreciatively recognised by the Press as an excellent example for other organisations to follow when attempting to further British trade. We have therefore decided on the widest possible distribution to Departments, Firms, and individuals likely to make good use of it, and we have asked the recipients if they cannot use it themselves to pass it on to someone who can and to give us addresses of any concerns to which further copies might be sent. In this way we have already distributed about 1,700 copies which is more than five times the number issued in 1927. We hope that members will benefit by this policy. The Directory has also been advertised in the recently issued Year Book of the Federation of British Industries and this will probably bring in further demands for copies. The new edition of "Some British Fine Chemicals" which is in essence a Fine Chemical Directory, will be widely distributed in the same way. The Directory is, as you know, issued only every second year, but already we have been considering the question of the next issue. It appears to be the general wish that all advertisements be excluded and that the financing of the Directory, which has in the past depended chiefly on the advertisements, be arranged in some other way. I think the idea of cutting out all

advertisements is an excellent one, and I know the General Manager has ideas for the publication of the next issue which will ensure an equally well produced volume at less than half the present cost.

Special mention must be made of the British Industries Fair and of the successful organisation of the Chemical Section. The arctic conditions which prevailed at the White City were enough to chill the ardour of anyone, and a move to some other site was practically forced on the Department of Overseas Trade. We should have liked to have seen a properly designed building erected on a suitable site, so that the British Industries Fair might come up to the same high standard of accommodation as continental fairs such as Leipzig and Lyons, but such a scheme had to be abandoned for financial reasons. The Department of Overseas Trade have now taken Olympia for the next ten years, and while the accommodation will be somewhat restricted at the start, the site will be more congenial and satisfactory than the White City in many ways. The General Manager has made a study of the chemical sections in the main continental fairs, and it is gratifying to find that our Chemical Section is far ahead of any other as regards the number, variety and technical interest of its exhibits. You will have noted that the Council's venture in arranging for special visits of chemistry teachers and students has met with a most enthusiastic response, and a large number of letters of appreciation were received from the Universities and Colleges which took advantage of the offer. The Council felt that by taking this course it would be stimulating and maintaining the connection between research and industry, and that the younger generation of students who will become the teachers and research workers of the future would have a unique opportunity of learning the latest achievements of British Chemistry and of appreciating that the British Chemical Industry is now second to none. If imitation is the sincerest form of flattery, it is pleasing to note that other Sections of the Fair propose to follow our example next year. I have nothing to add regarding the Barcelona Fair except that the French, German and Italian chemical industries are represented, and that it would have been unfortunate if we had been entirely out of the picture. This was the reason why we have made the arrangements we have, in spite of the difficulties of trade with Spain due to tariff policy. As regards publicity and propaganda, I have nothing to add to the Report.

The subject of legislation has not caused us much trouble during the past year, but we can hardly hope for a continuation of this happy state of affairs, and we must be prepared to deal with such matters as they arise. Tariff questions are always a fruitful source of controversy, and it cannot be said that the past year has provided much relief from tariffs from the point of view of British trade. It was hoped that the recommendations of the Economic Conference of 1927 would have led to an all-round reduction of tariffs, but this hope has not been realised. In fact there have been definite increases in certain tariffs since that time, and the most that can be said is that the Economic Conference has had a useful braking influence on the upward trend of tariffs. This is a problem which must be closely watched in future.

The Association has again prepared a Memorandum on the British Chemical Industry for the League of Nations and has received copies of the corresponding Memoranda from Germany, Italy, Poland and Upper Silesia. Belgium and France were also asked by the League, but did not reply. All these documents contain valuable information, but unfortunately the basis on which they are prepared and the form in which the information is set forth varies so widely for different countries that it is hard, if not impossible, to draw accurate comparisons from the data provided. The League of Nations is, however, endeavouring to secure some measure of uniformity to overcome these difficulties.

I am glad to say that I am able to comment more favourably than my predecessor last year on that hardy annual "statistics." Considerable progress has been made on schemes for the collection of production data in various branches of the industry, and I would like in particular to comment on the progress made in regard to the Fine Chemicatl Industry. This branch of the industry is enjoying the protection afforded by the Safeguarding of Industries Act which normally has seven more years to run, but the position may be reviewed by the Government at any time. The Association must therefore be prepared at short notice to present a case to justify the safeguarding protection and to prove that the fine chemical manufacturers have taken full advantage of the safeguarding to develop the industry and to bring it to a high state of efficiency.

(To be continued.)

NOTICES OF BOOKS.

Fifty-Third Annual Report of H.M. Inspectors of Explosives (1928) Pp. 51. H.M. Stationery Office. Price 1s. net.

This report deals with the modifications in the law relating to explosives, to the inspections, manufacture and storage, packing and conveyance, importation and accidents (one less than in 1927).

The section dealing with accidents is most detailed, and it is gratifying to find that in spite of increased manufacture and use there is also a decrease in the number of fatal accidents and a substantial fall in the number of persons injured during the manufacture or use of explosives.

Part II of the *Report* deals with the storage and use of petroleum, calcium carbide and carbon bisulphide, and there are appendices summarising some of the statistical matter presented in the report.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

THIONEX.

499,006.—Chemical substances for use as accelerating agents in the vulcanisation of indiarubber.—E. I. Du Pont de Nemours & Co., 1007, Market Street, City of Wilmington, State of Delaware, United States of America. July 24th.

SIWOLL.

499,644.—Chemical substances in class 1 for steeping, colouring and brightening textile fabrics, and leather in the course of manufacture, but not including coal tar colours.—H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Germany. July 24.

GENZYME.

499,981.—Chemical substances used for agricultural and horticultural purposes.—Forsyth Jones and Company, Limited, 14, Southampton Street, Strand, London, W.C.2. July 24.

MURPHITE.

503,556.—Chemical substances used for agricultural and horticultural purposes. —Seedolin Company, Limited, 21, Lower Mall, Hammersmith, London W.6. July 24.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—SOUTH AFRICA, 1929.

THE RELATION OF ORGANIC CHEMISTRY TO BIOLOGY.

Address by PROFESSOR GEORGE BARGER, M.A., D.Sc., F.R.S., President of Section B (Chemistry). July 23, 1929.

(*Continued from page 85.*)

Whilst organic chemists are often eager to investigate the constitution of animal and vegetable substances, they are less ready to undertake the preliminaries of purification and isolation, and are therefore less apt to discover new ones. By esterification and by the use of a high vacuum Emil Fischer made the monamino acids amenable to fractional distillation, a standard operation of organic chemistry. He discovered several new members of the group. But most substances of physiological interest require a special technique, on the development of which the biochemist may spend much labour. Thus Kossel showed how to separate the purine and pyrimidine bases of the cell nucleus, and the important diamino-acids, histidine, arginine, and lysine. Hopkins, by his special reagent, was able to isolate tryptophane, the parent substance of indigo, long after indigo itself was being manufactured synthetically. Dakin found that monoamino acids can be extracted from aqueous solution by butyl alcohol, and using this new technique and Foreman's method of separating aspartic and glutamic acids by their calcium salts, Dakin discovered hydroxyglutamic acid, an entirely unsuspected unit of protein. A knowledge of the structure of amino-acids, may throw light on how other nitrogeneous constituents arise, particularly in plants. As an example the most recently discovered amino-acid may be quoted. The American bacteriologist Mueller found in casein and other proteins a new constituent containing sulphur, quite different from the well-known cystine. Dr. Coyne and I have recently established its constitution by synthesis. It turns out to be γ-methylthiol-α-amino-n-butyric acid, $CH_3.S.CH_2.CH(NH_2)COOH$, and we named it methionine. the methylthiol grouping at once indicates that it is the source of methylmercaptan, the occurrence of which in putrefaction was known, although not hitherto intelligible. Methionine is evidently also the parent substance of cheirolin occurring in the seeds of the wallflower and of other Cruciferae. Schneider had long ago established for this substance the remarkable constitution $CH_3.SO_2.CH_2.CH_2.CH_2.N.CS$. We now see at once that cheirolin is the thiocarbamide of oxidised and decarboxylated methionine. Similarly Perkin and Robinson connected the chemistry of harmine and harmaline with tryptophane when they showed that the mysterious base $C_{12}H_{10}N_2$, which Hopkins and Cole obtained by oxidising tryptophane $C_{11}H_{12}O_2N_2$. This observation not only settled the constitution of the alkaloids in question, but also explained the fitful yield of the oxidation product of tryptophane, which, after decarboxylation, had condensed with acetaldehyde. Soon afterwards Späth showed that harman itself occurs in nature, as the alkaloid aribine, which had been given the erroneous formula $C_{23}H_{20}N_4$. It is becoming increasingly evident that many alkaloids arise by condensation of amino-acid residues. Mezcaline and other alkaloids of Cactaceae are closely connected with phenylalanine and tyrosine, as Späth has shown, and the mode of origin of isoquinoline alkaloids from aromatic amino-acids has also become clear. Harmine, harmaline, physostigmine, and rutaecarpine are all derived from tryptophane, and it looks as if the same is true of other alkaloids whose constitution, like that of strychnine and of brucine, remains obscure.

The isolation of some natural substances, of great physiological interest, is beset with difficulties, because they are present in minute amount and have not the convenient solubility relations, which facilitate the separation of the alkaloids. This applies to the hormones present in animal tissues. Here the American slaughter-houses provide valuable facilities, and it is significant that adrenaline, thyroxine, and insulin were first crystallised in America, although the constitution of the two former hormones was later established in Europe, where also their synthesis was effected, that of thyroxine only a few years ago, through the brilliant work of Harington. The difficulties of isolating vitamins is still more formidable; in the case of the antineuritic vitamin B, which is almost certainly a fairly simple substance, susceptible to attack by the methods of oranic chemistry, most progres towards isolation has been achieved by selective adsorption and elution, the methods employed by Willstätter for enzymes. The discovery by Rosenheim and Windaus that vitamin D is formed by the irradiation of ergosterol has suddenly brought into prominence a sub-

stance which before was but a curiosity, chiefly known through the work of the French pharmacist, Tanret. At the same time the interests of biochemists in photochemistry has been stimulated, as well as in the extensive work of Windaus on the structure of cholesterol, which the latter had already shown to be connected with the bile acids, largely investigated by Wieland.

The sudden emergence of ergosterol into prominence does not stand alone; another of Tanret's erot substances ergothioneine, at first also an isolated curiosity, has acquired more general significance because it has been found in mammalian red corpuscles; it is likely that this will ultimately lead to the discovery in proteins of yet another sulphur-containing amino-acid, possibly a thiol histidine. Altogether ergot has yielded more substances of general biological interest than any other single plant.

The above examples of the relation between biological and organic chemical work relate to that division of biochemistry which may be termed descriptive. A knowledge of structure is also necessary in dynamic biochemistry, the study of the transformations which substances undergo in the living organism. The recognition of the fats as esters, and their behaviour to fat-splitting enzymes, the transformation of starch into sugar under the influence of diastase, the end-products of alcoholic fermentation, all these were early discoveries in dynamic biochemistry. But just as the organic chemist may wish to know the mechanism of a reaction, for instance of the Skraup synthesis of quinoline, so the biochemist wishes to know the *intermediate steps in the transformation* of say glucose into alcohol. The detection of these stages of metabolism is a matter of considerable difficulty, since under normal conditions the intermediate substances generally disappear as rapidly as they are formed. They have to be trapped by suitable means, as did Neuberg with acetaldehyde in alcoholic fermentation, or the metabolic process may sometimes be cut short, by using an isolated organ, such as the surviving liver, or the precursor of the intermediate substance may be administered in large excess. Very little has been learned in this respect from the higher plants. The very provess of photosynthesis is still beset with obscurity in spite of a plausible hypothesis; we know next to nothing about transformation of carbohydrate into fats, and *vice versa*, and in particular we are ignorant of the stages by which amino-acids are formed in plants from nitrates and carbohydrates; we simply do not know how the proteins of living being originate. Nor have the higher plants given us much information of the way in which their fats, carbohydrates, and proteins are ultimately broken down. Our knowlede of catabolism is principally derived from the animal world. It is found that the breakdown does not always occur in the manner in which the organic chemist would expect. Thus an organic chemist presented with the problem of transforming stearic acid into palmitic might brominate in the alpha position, and break down the corresponding α-hydroxy acid; or he might do a Hofmann degradation on the amide. In either case he would get an acid with 17 carbon atoms, and have to repeat the degradation in order to obtain palmitic acid. Knoop has shown, however, that in the animal organism the β-carbon atom is attacked so that the chain is shortened by two cargon atoms at a time, an acid with 18 carbon atoms being converted successively into one with 16, 14, 12, etc. In accordance with this scheme the principal fatty acids in nature are those with an even number of carbon atoms. Knoop established this by feeding ω-phenyl fatty acids; those with an even number of methylene groups in the side chain were converted into benzoic acid and appeared in the urine as hippuric, those with an odd number of bethylene groups yielded phenyl acetic acid and were excreted as phenaceturic acid.

Instead of using a resistant phenyl group and the whole animal, fatty acids themselves and the isolated liver may be used to establish the same result. Embden perfused the ten lowest members of the series of fatty acids through a surviving liver and obtained acetone formation only with those having an even number of carbon atoms; they are converted by β-oxidation finally to acetoacetic acid, from which acetone results. Dakin found in hydrogen peroxide an oxidising agent which closely imitates the biochemical method *in vitro* and at a low temperature; thus butyric acid gives acetoacetic, and the higher fatty acids give methyl ketones, with loss of carbon dioxide.

The same method of oxidation seems to occur in the vegetable kingdom, for plants are apt to contain ketones with an even number of carbon atoms in addition to a methyl group. Thus methylamyl-, methylheptyl- and methylnonyl-ketones of essential oils doubtless result from the recarboxylation of β-keto acids, as in Dakin's experiment, with hydrogen peroxide.

The degradation of amino-acids in the body also proceeds contrary to the expectations of the organic chemist. If he were asked to bring about the degradation by gentle stages he would doubtless first convert the α-amino into the α-hydroxy acid. The organism forms the α-keto acid, however, as shown by Neubauer and by Knoop. This biochemical result suggested to Knoop an interesting and unlooked-for synthesis of amino-acids *in vitro*, by reversing the normal breakdown. He shook solutions of α-keto acids, containing also ammonia and platinum black, in a hydrogen atmosphere when the corresponding amino-acid resulted by the reduction of the hypothetical imino compound.

INFRA-RED SPECTRA.

By Sir Robert Robertson, K.B.S., M.A., ... F.R.S., Secretary, Royal Institution.

(*Lecture delivered at the Royal Institution on March 1, His Grace the Duke of Northumberland, K.G., C.B.E., M.V.O., President, in the chair.*)

In 1800 the elder Herschell, by placing a theomometer in the region lying beyond the visible red of the solar spectrum, gave the first experimental proof of the existence of radiation there by observing a rise in temperature of the instrument, and his son in 1840 described the existence of emission bands in the same region as shown by a discontinuous evaporation of alcohol from blackened paper placed in the same region.

To illustrate action beyond the visible red of the spectrum the following experiment was made. As it was impractical to use the sun's spectrum, the beam from an arc lamp was dispersed by means of a large rock-salt prism, giving the usual spectrum visible to the eye. A card on which a phosphorescent powder (calcium sulphide with nickel as impurity) was first caused to glow brightly by subjection outside the theatre to ultra-violet light from a mercury lamp and then placed in the spectrum, when the existence of radiation beyond the visible was shown by the quenching of the phosphorescence for some distance past the red.

This region of the spectrum attracted much interest from the middle of last century and onwards, when instruments of increasingly refined character were evolved to detect and measure effects of emission and absorption of radiation there. Thus photography was tried ,and Abney succeeded in penetrating the region for a short distance which has not been exceeded by more recent workers employing special sensitisers for their plates. Langley with the bolometer, Boys with the radiomicrometer, and Coblentz with the thermopile, succeeding in measuring quantitatively radiation in the infra-red; the last two instruments are the principal ones employed to-day in that region which lies nearest to the visible. Still farther out measurement of the energy in the beam dispersed by means of reflection from the polished surface of crystals gave important results in the hands of Rubens and his colleagues, while within the last year Raman, by an entirely different technique, to be mentioned later, has indicated how infra-red radiations can be deduced from spectroscopic measurements in the visible spectrum.

Dispersion by means of a grating having been referred to, a modern infra-red spectrometer of Hilger was then described as to its respective parts, the source of radiation (a Nernst filament), the slits, the reflecting mirrors, the dispersing prism (of quartz up to 3μ, of fluorite up to 8μ, of rock salt up to 17μ, or of sylvin up to 23μ), and the thermopile. Special reference was made to the thermopile, composed of bismuth-silver couples used in conjunction with a galvanometer for measuring the energy passing through the instrument. Its sensitiveness was illustrated by allowing a little compressed air to enter a sealed bell-jar containing the instrument, when, by adiabatic compression of the air, the heat generated was registered by movement of a spot of light from a Moll galvanometer.

Bands due to both oscillation of the atoms in the molecule and rotation of the molecule itself are found in the infra-red spectrum. Oscillation bands were shown by Drude, from the phenomenon of dispersion in crystals, to be necessarily present having wave-lengths such as occur in this region of the spectrum, if certain smaller charged particles (electrons) are concerned in the ultra-violet region. As the effect is one of resonance, the atoms in a molecule respond in their vibration to radiation possessing some particular frequency, and this was illustrated by a model in which a ball suspended on a spring from the end of a light rod supported on two nodes was made to perform vertical oscillations, whereupon a ball similarly suspended at the other end of the rod picked them up and vibrated vertically in phase with the former ball. The electronic linking between the atoms prevents their oscillation being truly sinusoidal; harmonics may therefore be expected and are in fact found. This was illustrated by a

table from the work of the author and Dr. Fox on NH_3, PH_3 and AsH_3.

Molecules also undergo rotation, and this effect is reflected in their infra-red spectra. It was pointed out that the main bands were due to oscillation, but that in addition the rotation of the molecule also produces bands, of a simple character, in the far infra-red, but in the near infra-red as fringes superimposed on the oscillation bands. Rayleigh, assuming on the basis of classical mechanics a Maxwellian distribution of velocities, in 1892 showed that an oscillator emitting and absorbing at a frequency ν_0 due to its oscillations alone would, when rotating about an axis perpendicular to its line of vibration with a frequency ν_r, emit and absorb at the new frequencies $\nu_0+\nu_r$ and $\nu_0-\nu_r$. This seemed at first to meet the case, as in some of the early bands such as those of Burmeister two broad areas occurred which the Maxwellian distribution of rotational velocities would require. In 1911, however, Nernst concluded that rotation must also be quantised, and in 1912 Bjerrum and E. v. Bahr resolved a band of HCl into a series of small bands, which they ascribed to the effects of rotation of the molecule.

In the first place we get the frequency of oscillation of the atoms within the molecule, and the frequency of rotation of the molecule itself. These have been shown for a simple molecule such as that of HCl.

But, in addition, with more complicated molecules, it is possible to construct models by taking into consideration the presence of absorption bands and assuming a law of force between the atoms in the molecule. Thus Hund for NH_3 considers that it has a tetrahedral structure, and this is probably also the case with the analogous PH_3 and AsH_3. With these gases have been found at least three sequences of bands in each, corresponding with three degrees of freedom of oscillation, one of the sequences in each gas having five or six harmonics. In this sequence the frequency of vibration gets slower as the weight of the atoms N$\longrightarrow$P$\longrightarrow$As increases in the three gases.

It is interesting from the chemical point of view to see if any of these degrees of freedom correspond to the chemical bonds of the chemists, and some hint of this is obtained in one case at least. Thus by progressively substituting the H in NH_3 by CH_3 a certain band—the first harmonic of the main sequence mentioned above—disappears from the spectrum after the last H has been substituted, so this degree of freedom of oscillation has been identified as connected with the chemical bond N-H.

Again, as regards rotation we have found two moments of inertia in NH_3 of which one can be attributed to rotation round the median line and the other round the centre of mass at right angles to the median line. Calculation of the length of the molecule, as above described, gives a value similar to, although somewhat smaller than, that obtained by Rankine from measurements of viscosity of this gas.

By the comparison of spectra of related compounds, as for example in the case of hydrocarbons, definite bands have been attributed to certain groups or radicles. In the case of solids certain groupings such as NH_4^+ or CO_3^- have similarly been identified in the spectrum of salts.

In the hands of Coblentz infra-red data and technique have been used to determine the quantity of radiation from the sun, stars and planets, and he has also deduced the temperatures which prevail in these bodies, and even the differences in radiation from the hemispheres of Mars.

The knowledge of the infra-red spectrum of water vapour and of CO_2 is of importance in considering the nature and quality of energy reaching us from the sun, and only recently Dr. G. C. Simpson, by making use of the absorption coefficients of water and carbon dioxide in the infra-red, has deduced that an increase in solar radiation would result in increased cloud and precipitation and even in the apparent paradox of an ice age. Further, Paschen's determination of the emission and absorption bands of these gases is fundamental in questions relating to combustion.

Such are some of the results that spring from the consideration of infra-red spectra.

On the more theoretical side it has thrown light on and given support to the quantum theory. It has passed into the hands of the still more modern exponents of the wave mechanics and found to be in accord with their predictions, as for example in connection with the assumption of half quantum numbers. This is a field in which its usefulness is only beginning.

Only last year Prof. Raman, of Calcutta, by imposing monochromatic radiation from a mercury lamp on gases and liquids, observed spectroscopically in the scattered light not only the original line but also others at frequency differences which he finds are equal to frequencies in the infra-red at which bands characteristic of the gas or liquid were known. This brilliant experi-

mental confirmation of the quantum theory may prove of the highest importance from a theoretical point of view when it comes to be explained why in the Raman effect not all the bands found in the infra-red by the usual means appear, and why others appear to be disclosed only by the Raman effect.

Like the X-rays it deals with the structure of the molecule, but while X-rays reveal the molecule in its static condition and are especially applicable to solids, infra-red spectra reveal the dynamic characteristics of the molecule in gases, liquids, and to a restricted degree in solids. In the future it will undoubtedly be used to a greater extent in the determination of the nature of chemical linkages, and generally for a solution of problems of chemical constitution.

As Garner and his school have shown, important deductions can be made as to the rôle of infra-red radiation in combustion, as, for example, in the effect of water, when it is present, in carrying off the energy of radiation produced when CO combines with oxygen, and as the bulk of the radiation from flames is in the invisible part of the spectrum and mainly in the infra-red, there is here a wide field of work in clearing up the mystery of flame, and the same is true as regards the phenomena of explosion of both gaseous and solid explosives.

It is to be regretted, however, that more work is not being done in this country in the exploration of this region. It is true that the technique is difficult, and there have been several investigations reported the accuracy of which leaves a good deal to be desired. Most of the work up till now has been done in Germany and in the United States, little so far having come from our Universities, with the exception of Cambridge, where there is an embryonic school.

The subject is perhaps scarcely one suitable for a young graduate to acquire the technique and embody a year's work in a thesis for some degree, but one for a more permanent staff; and I should like to make a plea for its greater consideration in this country as a field of experiment and study likely to assist in the solution of many physical and chemical problems, which in due course will have its reflexion in the domain of technical application.

Sir J. J. Thomson has given us the electron, Rutherford the proton with its planetary electrons and the structure of the proton, the Braggs have elucidated the structure of many molecular fabrics, but the molecule as a dynamical entity has been comparatively neglected. For it is in the infra-red region of the spectrum that this behaviour can best be studied. In this aspect the problem is a physical one for the most part; the technique is difficult, but likely to be productive of much that is important in our conception of the structure of matter. It is for this reason that one would like to see in this country a strong school arise having as its object the study of the dynamical behaviour of the atoms in the molecule and of the molecule itself.

THE HEAT TREATMENT OF HIGH TENSILE ALUMINIUM ALLOYS.

By A. R. Page.

It is only within recent years that forgeable aluminium alloys have been developed. Thirty years ago, aluminium was considered to be comparatively rare, but to-day it is one of our commonest metals, and one which every day is finding further applications. It was natural that aluminium, presenting quite novel features over the copper and iron alloys, should receive a great amount of attention from research workers with a view to improving the mechanical properties of the metal. Although possessing the important property of lightness, being only about one-third the weight of iron or steel, bulk for bulk, the mechanical properties of pure aluminium are very poor, and in the unalloyed state this metal is quite unsuitable for the manufacture of any articles which are required to withstand high stresses.

Copper and zinc were the first two metals to be added to aluminium, with considerable improvement in strength. These alloys, however, were used in the cast condition, originally as sand castings, and more recently as die-castings. The latter process has proved a very economical development, since very clean castings can be produced to very close dimensional limits, which eliminates machining to a large extent.

Unfortunately, however, aluminium alloy castings are very brittle. They possess a very low impact value and for this reason their application is limited.

The introduction of the so-called forgeable aluminium alloys has revolutionised the ideas on the application of this series of alloys. These materials contain comparatively only small amounts of alloying elements, and in the normal state, the mechanical properties are not much better than those of aluminium itself. It was found, however, that these alloys could be heat treated and thereby their mechanical properties improved, much in the same way that the pro-

perties of steel can be increased by hardening and tempering.

The value of these alloys has, therefore, been enormously increased since they not only possess a very high ductility and considerable toughness. We have, consequently, a material which can be forged in dies, as steel can be, and which can be heat treated to give properties equal to mild steel in every respect, coupled with the fact that the articles are only one-third the weight.

In these days of the rapid development of machinery of all types, reduction in weight, not only of moving parts, but also of "dead weight" components, contributes enormously to mechanical efficiency and here one can see a very big field. For example, pistons are now being manufactured as castings, which in many cases are being heat-treated. In this case, toughness is not a very vital factor, but here, the reduction in weight to one-third, of a highly reciprocating part such as a piston, mus of necessity improve the efficiency of the engine. Crank cases and gear boxes also are made as aluminium alloy castings. This is an example of reduction in dead weight.

When, however, oue considers the question of such a component as a connection rod, a casting would immediately be found to be unsuitable. In this case, one requires not only mechanical strength, but also toughness and resistance to shock. An aluminium forging is used therefore. Such articles as axles, wheel centres, etc., are also made as forgings which have been suitably heat treated.

The advantage of these materials is that they can be worked not only when hot, as in forging, or drop stamping, but also they can be rolled into bars and sheets, or drawn into wire or tubes, on account of the high ductility which they possess.

The composition of these alloys of which Duralumin was the first to be developed, are such that they contain only about 4 per cent. of copper and small amounts of silicon, manganese, iron and, in some cases, nickel and magnesium.

The improvement in mechanical properties presents a very interesting phenomenon. Heat treatment consists of two operations, as in the case of steel, (1) a quenching and (2), a tempering, but the effect of these operations is somewhat different from those in the case of steel. In the latter case, quenching imparts an intense hardness to the material and tempering reduces this hardness and consequently the mechanical strength but increases the ductility.

Quenching in the case of the wrought aluminium alloys, does not harden the material, but puts it in a certain state so that subsequent tempering causes hardening and an increase in strength. As a matter of fact, after quenching, the mechanical properties are no better than they were in the raw state, but by tempering the properties gradually improve. This improvement may be caused through artificial means or may take place spontaneously, according to the composition of the material. Such materials as Duralumin increase in strength spontaneously at ordinary temperatures after quenching. This increase in strength takes place gradually together with an increase in hardness over a period of about seven days, after which time the material has attained its maximum properties. The process may be accelerated by heating the quenched material to some low temperature, about 150° C. for several hours.

Other alloys of somewhat diffierent composition do not harden spontaneously, but require the artificial tempering to confer the improved properties. This phenomenon of hardening up after a certain time is called "Age-Hardening."

The property of spontaneous hardening, while useful in some respects, has its disadvantages. For instance, in the manufacture of pressed or drawn articles, the material has to be worked up immediately after annealing. Otherwise, the metal hardens up to such an extent as to cause difficulty in the drawing operation. With the other types of alloy, a stock of partly formed components can be kept indefinitely without any fear of hardening up.

Materials of the Duralumin type, which contain copper, magnesium and silicon, spontaneously harden at ordinary temperatures. The theoretical explanation of this is that, soaking at the quenching temperature allows the compounds of aluminium and copper and silicon and magnesium to go into solid solution, which state is fixed by rapid cooling in water. The magnesium silicide, however, gradually precipitates from the solid solution in a very finely dispersed form at ordinary temperatures and causes the increase in mechanical properties. In the case of the other types of alloys, the essential constituent is copper, but it is necessary to raise the temperature to about 150° C. to cause the copper-aluminium compound to be precipitated. This it will not do at ordinary temperatures.

The treatment of aluminium alloys has to be carried out with considerable more care than in the case of steel. When it is remem-

bered that the melting point of pure aluminium is only about 657° C. as compared with 1500° C. for steel and that of the alloys is somewhat less, it will be realised that the temperature ranges for these alloys are much narrower than for the ferrous materials.

Extreme care has to be exercised, not only with the heat treatment, but also with the forging. This is where electric furnaces must, of necessity, have a very big future, and it is safe to say that already they have met with a large amount of success in this connection. In fact, it is true that the only type of furnace which can be used successfully for this class of work is the electric furnace, mainly owing to its cleanliness, uniform temperature, absence of flame, and what is very important, very exact control of temperature. It is almost essential, therefore, that the furnace should be fitted with altomatic temperature regulation.

The old method of judging the forging temperature of an aluminium billet was to test it with a piece of paper, which should just char. This was very crude and has been replaced by electric resistance furnaces whose temperature regulation is carried out entirely automatically. The forging range is very narrow, and it is practically impossible to attain these close limits in any other type of furnace.

The temperature ranges for the two heat-treatment operations also are very close. In the case of the quenching operation, for the alloys which do not harden spontaneously, the range is 965-985° F.—only a range of 20° F., while for the second treatment only 15° F. is allowed, *i.e.*, 300-315° F., so here again it seems essential that electric furnaces should be used.

It might be interesting here to give some figures showing the effect of artificial ageing :

The test bars were all quenched from 965-985° F. and aged at 300-315° F. for different periods of time. The results are as follows :

	Ageing Period at 300-315° F.			
	None	4 hrs.	8 hrs.	16 hrs.
Yield Stress. Tons per sq. in.	8.0	10.5	13.0	15.5
Ultimate Stress. Tons per sq. in....	20.4	22.0	22.0	25.0
Elongation. % ...	26.0	24.0	19.0	[illegible]
Red'ct'n of area %	45.0	40.0	25.0	32.0
Brinell Hardness	70.0	88.0	95.0	105.0
Izod Impact. ft.lbs	31.0	24.0	22.0	16.0

From these figures it will be seen how the yield and ultimate stresses have increased while the ductility has been reduced. The hardness has also increased until the properties, after 16 hours' treatment, approach those of mild steel.

The compositions of the two types of material are somewhat different. Herewith are given two actual analyses, from which a comparison can be made :

		Spontaneous Hardening	Artificial Hardening
Copper	%	4.02	3.62
Silicon	%	0.25	0.88
Manganese	%	0.65	0.53
Zinc	%	tr.	tr.
Magnesium	%	0.82	tr.
Iron	%	1.24	1.68
Nickel	%	nil	tr.

The practical absence of magnesium in the second analysis will be noted.

Summing up, it cannot be over-emphasised that very close attention must be paid to the temperatures of treatment of these alloys, in order that the best results should be obtained. These results, however, cannot be obtained with certainty and satisfaction unless electric furnaces are employed, fitted with automatic control. Such furnaces are manufactured by Wild-Barfield Electric Furnaces Ltd., and will be found to be most suitable for these operations, not only for heat treatment but also for forging. Numbers have already been installed and are giving every satisfaction.

ENGLISH ARCHITECTURE.

By A. E. Richardson, Professor of Architecture, University of London.

(Abstract of a paper read before the Royal Society of Arts.)

English architecture of to-day expresses contemporary life. It can be divided into five categories—

(*a*) Commercial architecture — offices, banks, warehouses, factories, transport buildings.

(*b*) Housing—town and country houses, cottages, farms, etc., etc.

(*c*) Civil—post offices, town halls, schools, bridges.

(*d*) Religious buildings — cathedrals, churches.

The bulk of the work comes under (*a*). Here we find traditional materials cloaking the skeleton structure which is the real building. We have yet to devise the efficient

factory, the attractive city office, the best form of garage, and the right type of bank. The bank, it is true, has gained a certain ostentatious character. Generally, the bank is a classical building bedizened with unnecessary ornament. Scholarship combined with efficient structure is the leaven required.

Housing in town and country comes next. Climatic conditions fortunately must still be observed. During the past four centuries brick has been found the most suitable material. The housing question has evolved a new cottage style for villages and garden cities. The best work of this class has charm; it is free in design, logcal, economical, and typically English. The people who live in these new cottages and small houses know little about architecture, but they are content with their homes. Modern housing in towns and cities proceeds on the lines of communal dwellings and flats. The best of the latter have uniformity. The planning is reasonable, the elevations pleasant and sunny. No other country has evolved similar buildings; they satisfy the Englishman's thoughts of home and have a familiarity which is friendly and human. Such buildings represent the view point of English architects.

The civic buildings come next.

I doubt whether you will encounter better post office buildings than those erected by His Majesty's Office of Works. The planning of schools has improved, thanks to the Board of Education. In the design of bridges, England is not behind any other country. The new Border bridge is among the modern triumphs. The new steel bridge at Newcastle-on-Tyne has all the daring of Telford's masterpieces across the Menai Straits. The new bridge in massed concrete is a thing of beauty. And so on and so forth. But the good things are overshadowed by masses of *mere building*, not fine building.

You will be astonished at the excellence of design of many new churches. True, such buildings exhibit Gothic principles, but they are otherwise up-to-date. The plan of Liverpool cathedral is original, even if the detail is mediæval. There are churches recalling Byzantine formations, and structures of plain brick, of stone, and concrete, which belong to this age and no other.

Once more I will hold the mirror up to the best of contemporary English architecture and show it to be *architectonic.* In the main it is the outcome of 19th century experiment. But there are some who say that this peculiarly English expression does not go far enough. Such critics would have English architecture more cosmopolitan in character. They would have Englishmen express themselves as Germans, Frenchmen, Americans, Dutchmen, Swedes, and a score of nationalities. It is imagined, somewhat vainly, that other countries hold the formula for architecture. Hence the English preference for foreign artists with names ending in "ski" or "stein." How pathetic it is that young Englishmen trained in the schools should be forced to seek employment away from their own country.

We will now examine the foreign influences.

Denmark.—Here the modern architecture is mainly based on tradition. It is orderly, human in scale, unostentatious, reasonable, aristocratic and direct.

Sweden.—Similar to Denmark. More adventurous, more regard for structural integrity, beautiful in detail, economic in expression. Architectonic to a degree.

Germany.—The whole country organised to capture the world's commerce. The finest factories, shops, warehouses, and railway stations. Cinemas, theatres, and dance halls of novel character. Domestic architecture generally of the old Nuremberg style, mock half timber, beetle-browed roofs, squint dormers; in this apeing "ye olde English" copy-book style. The reverse shows vast blocks of flats for the workers, strange houses of small scale, built of concrete. The robot population of Germany accepts such things without complaint. Teuton efficiency has produced new factory types. "Modernism" in Germany has made great headway. There is novelty of design in the planning of the larger buildings such as the Tietz stores, and ingenuity in the planning of factories for specific purposes.

The robotesque style has gained ground, but it does not provide a formula for all buildings. There is a tendency to design every new building to the same rulings, with the result that churches resemble factories and cottages are akin to boxes. The new style expresses industrial efficiency, but it is inhuman. Even the Germans refer to it as the marvel of engineering.

France.—The French define the term "modern" as intelligent evolution from tradition. They are right. Such buildings as those designed by the Perret brothers are very good indeed. The aeroplane and liner style of Messieurs Corbusier and Mallet Stephens has gained followers. But good

sense in architecture and the national regard for artistic culture preserves equilibrium.

Holland.—Here we find a definite break with tradition. A new treatment of the national brickwork combined with concrete. Novel blocks of working-class houses. Very good factories. A tendency to manufacture design and to dehumanise architecture.

America. — During the 19th century America experimented with the conventional styles of Europe. The culmination came with the classical fever, which added a giant order to the upper works of skyscrapers and adapted the Baths of Caracalla to railway stations. The works of Sullivan and Frank Lloyd Wright represent attempts to give America an indigenous style. They are partly successful, but they do not stand for an universal formula.

The chief contribution of America to the world's architecture is the modern skyscraper. This type of building would not have been possible but for the use of steel for the bones of the structure. The zoning laws have produced *zigguṛat* forms. The types have great beauty of silhouette. The vertical line dominates. The cultured view point of America at its best is expressed in the works of the late Charles Goodhue. This is a view point which respects tradition and, at the same time, allows scope for adventure.

Now the effect of these cosmopolitan commands upon the mentality of some architects in England is bewildering. There is little chance for steady evolution when all other countries are ruled by the demon of modernism at all costs. The illustrations of foreign buildings which reach English architects by every mail, and at the whim of every photographer, disturb the outlook. Fashion and a new sort of copyism are conjointly producing changes which are far from beneficial. From America has come the rage for skyscraper tops. From Germany has arrived the mania for bestial sculpture. Everywhere we see ill-digested versions of the robotesque. From France we have obtained the Mallet-Corbusier fashion, dictated by economy, frugality, and maturity. The Dutch bulbous style has not caught on, but we have much to learn from the Hollander in the treatment of commercial buildings. The quiet building manners of the Danes and the Swedes, analogous to the English mood of the 18th century, unfortunately are not appreciated.

Small wonder that English architecture should exhibit so many differentiations. When designed by men with knowledge of fine building the result is good. But at the hands of opportunists buildings become reminiscent of present-day continental experiment. At the call of democracy the art of building is at its worst. It has descended to the level of substitute materials such as "bungaloid."

THE COLLINSICS OF MINERALS. XIII.

By Hawksworth Collins, B.A. (Camb.).

In Table XVIII each one of the twelve collinsics contains iron in the ferric state. Its relative volume is 10.08 and optical refaactivity 19.58. This is the only new voloptic introduced, all the others having occurred in preceding collinsics.

As it seems necessary in each paper to explain one collinsic for the sake ofthose scientists who see the matter for the first time, No. 145 (Acmite) will now be discussed.

The thick type denotes the discovery, whilst the ordinary type gives experimental data which helped to produce it. The O.R. of each atom is placed directly under its R.V. The first line gives the chemical formula of the mineral, the Theoretical S.G. and the Experimental S.G. The second line gives (between the brackets) the R.V. of each atom in the molecule, and also the product of the sum of these volumes by $\mu-1$, where μ is the Theoretical Refractive Index of the mineral. The third gives the Theoretical R.I. followed by the Experimental R.I. The fourth gives the optical refractivity of each atom, and also the sum of these values.

There are four different voloptics in this mineral, that of Na being 11.865 and 3.865. These voloptics are common to all minerals in which they occur.

There are three colls, *i.e.*, three sets of values which belong to this mineral alone (a) the molecular weight divided by the sum of the relative volumes gives 3.57, which must be within one per cent. of the experimental S.G. (b) The theor. R.I., 1.79, must be within one per cent. of the exper. R.I. (c) The sum of the volumes when multiplied by $\mu-1$ must give the same result correct to four figures as the sum of the O.R.'s, 31.085 and 31.081.

All these requirements, which must be satisfied in each mineral, make a collinsic the most exact deduction from experimental facts, which has ever been produced.

TABLE XVIII.

	Theor. Column	Obs. Column	
(145) Acmite $Na + Fe + Si_2 + O_6$	**3.57**	3.55	D
		3.63	D
$51.085 = 0.79(11.865 + 10.08 + 13.83_2 + 2.51_6$	**1.79**	1.753	D
		1.8084	D
$51.081 = 3.865 + 19.58 + 9.78_2 + 1.346_6$			
(146) Strengite $Fe + P + O + O_3 + 2H_2O$	**2.89**	2.87	D
$49.019 = 0.75788(10.08 + 14.56 + 4.45 + 2.51_3 + 14.03_2)$	**1.75788**	1.745	S
		1.81	M
$49.019 = 19.58 + 10.51 + 1.747 + 1.346_3 + 6.572_2$			
(147) Scorodite $Fe + As + O + O_3 + 2H_2O$	**3.174**	3.18	D
		3.11	D
$56.164 = 0.7717(10.08 + 19.58 + 7.53 + 2.51_3 + 14.03_2)$	**1.7717**	1.765	S
		1.797	S
$56.166 = 19.58 + 17.75 + 1.654 + 1.346_3 + 6.572_2$			
(148) Gothite $Fe_2 + O_3 + H_2O$	**4.27**	4.28	W
		4.2	M
$49.77 = 1.193(10.08_2 + 2.51_3 + 14.03)$	**2.193**	N_m2.1-2.35	W
$49.77 = 19.58_2 + 1.346_3 + 6.572$			
(149) Magnetite $Fe_3 + O + O_3$	**5.121**	5.12	O Kopp
$64.430 = 1.4223(10.08_3 + 7.53 + 2.51_3)$	**2.4223**	2.42	W
$64.432 = 19.58_3 + 1.654 + 1.346_3$			
(150) Pyroaurite $Mg_6 + Fe_2 + C + O + O_8 + O_2 + 12H_2O$	**2.072**	2.07	W
$175.042 = 0.5496(8.71_6 + 10.08_2 + 8 + 4.45 + 7.53_8 + 2.51_2 + 14.03_{12})$	**1.5490**	N_o1.540	W
		N_e1.565	W
$175.037 = 6.0015_6 + 19.58_2 + 3.333 + 1.747 + 1.654_8 + 1.346_2 + 6.572_{12}$			
(151) Ludwigite $Mg_2 + Fe + B + O + O_4$	**3.985**	4.0	W
		3.91-4.02	D
$42.485 = 0.8682(8.71_2 + 10.08 + 3.865 + 7.53 + 2.51_4)$	**1.8682**	N_m1.85	W
		N_g1.98	W
$42.486 = 6.0015_2 + 19.58 + 3.865 + 1.654 + 1.346_4$			
(152) Quetenite $Mg + Fe_2 + S_3 + O_{13} + 13H_2O$	**2.12**	2.12	W
$170.954 = 0.5382(8.71 + 10.08_2 + 15.53_3 + 2.51_{13} + 14.03_{13})$	**1.5382**	N_m1.535	W
		N_g1.582	W
$170.9595 = 6.0015 + 19.58_2 + 5.75_3 + 1.346_{13} + 6.572_{13}$			

(153) Dufrenite $Fe_2 + H_3 + P + O_2 + O_5$

$$66.936 = 0.8408(10.08_2 + 5.76_3 + 14.56 + 7.53_2 + 2.51_5)$$

$$66.931 = 19.58_2 + 2.613_3 + 10.51 + 1.654_2 + 1.346_5$$

Theor. Column	Obs. Column	
3.24	3.233	P
1.8408 N_m	1.840	W

(154) Arseniosiderite $Ca_3 + Fe_4 + H_9 + As_3 + O_{21}$

$$214.917 = 0.8693(14.54_3 + 10.08_4 + 5.76_9 + 19.58_3 + 2.51_{21})$$

$$214.913 = 10.52_3 + 19.58_4 + 2.613_9 + 17.75_3 + 13.46_{21}$$

Theor. Column	Obs. Column	
3.7	3.52	D
	3.88	D
1.8693 N_o	1.870	W

(155) Chenevixite $Cu_2 + Fe_2 + As_2 + O_3 + O_2 + O_5 + 2H_2O$

$$132.59 = 0.881(9.54_2 + 10.08_2 + 19.58_2 + 7.53_3 + 4.45_2 + 2.51_5 + 14.03_2)$$

$$132.53 = 14.77_2 + 19.58_2 + 17.75_2 + 1.654_3 + 1.747_2 + 1.346_5 + 6.572_2$$

Theor. Column	Obs. Column	
3.88	3.9	W
1.881	1.88	W

(156) Beraunite $Fe_3 + H_3 + P_2 + O_2 + O_2 + O_7 + 2.5H_2O$

$$120.232 = 0.7846(10.08_3 + 5.76_3 + 14.56_2 + 7.53_2 + 4.45_2 + 2.51_7 + 14.03_{2\cdot5})$$

$$120.253 = 19.58_3 + 2.613_3 + 10.51_2 + 1.654_2 + 1.747_2 + 1.346_7 + 6.572_{2\cdot5}$$

Theor. Column	Obs. Column	
2.96	2.87-2.98	W
1.7846 N_m	1.786	W

MASS NUMBERS OF THE CHEMICAL ELEMENTS AND OBSERVATIONS ON ELEMENT FORMATION — A SUPPLEMENTARY NOTE.

By F. H. Loring.

In *Nature* of July 27, 1929, *124*, 127, A. S. King and R. T. Birge announce the spectroscopic discovery of an isotope of carbon of mass number 13, the assumed mass or atomic weight being given as 13.0026 if carbon is taken as 12.0000.

These authors say—" We cannot at this time make any statement relative to its abundance, except to say that the isotope band is hundreds of times as faint as the strong band."

It is to be noted that the present writer in *The Chemical News* of July 5, 1929, *139*, 1, under the title as above, discussed such an isotope, but thought that it would be a nitrogen isotope, its mass number being 13.

It should be remembered that conjectural studies, while aiming at the truth, often fall short of it in some feature. Therefore, such studies should be considered with this possibility in mind. Speaking generally, the trained experimentalist has the high honour of being more often correct in his work, whilst the speculator is content with an approximation to the truth, but sometimes he is entirely *in error, as of course all know.*

The activity at the present time in studying band spectra with the object of revealing the presence or influence of isotopes in connection therewith is further exemplified by two papers in the *Physical Review* (July 1, 1929, *34*, 44 and 58); one by C. F. Meyer and A. A. Levin on the absorption spectrum of hydrogen chloride, and the other by W. F. Colby on the analysis of HCl bands—the latter paper (p. 58) successfully applying formulæ derived from wave-mechanics to the measurements as recorded in the former paper (p. 44), where the isotopic effect is beautifully revealed. References to other work leading to these results need not be given here as the reader interested should study the original papers.

This note affords the opportunity of correcting a spelling fault on p. 2, column 2, 26th line up—" Giaque " should read Giauque.

GENERAL NOTES.

IRON ORE INDUSTRY IN SPAIN.

The situation of the Spanish iron ore industry at the end of 1928 showed little change from that at the beginning. The prices of Vizcavan ore in 1928 were approximately those of 1927—for first grade iron ore from 20 to 24 pesetas; second grade 15 to 20 pesetas; third grade 13 to 15 pesetas; for carbonate mineral, first grade, 18 to 23 pesetas, and 15 to 18 pesetas for second grade.

It is reported by the American Commercial Attache at Madrid that the exportation through the port of Bilbao during 1928 was 1,850,000 tons, as against 1,619,000 tons in 1927. The shipment of mineral from Vizcayan deposits for national and foreign plants, however, amounted to 2,609,000 tons in 1928, as compared with 2,586,000 tons. Shipments of mineral from Vizcayan mines to national mills, amounted to 540,000 tons. The total production of iron ore in the province of Vizcava during 1928 was 2,445,000 tons ,as against 2,247,000 tons in 1927. Stocks of iron ore in the deposits of Vizcavan mines amounted to 480,000 tons at the end of 1928.

COKE AS FUEL FOR TRACTORS.

Considerable interest, both from an economic and a national point of view, attaches to the possibilities of the use of coke or charcoal as motor fuel. In this country ample supplies of residual coke are available at a price much below that of imported liquid fuels, and it only remained to evolve a practicable method of utilisation.

It is interesting to note that a firm has recently given a series of working demonstrations of the practicability of using coke, produced by low temperature carbonisation processes, as a fuel for a standard farm tractor, fitted with their patest producer gas plant, executing ploughing work. It is claimed that ploughing has been carried out by this means at a fuel cost of 11d. an acre. In countries overseas, where timber is abundant, charcoal can be utilised in place of coke.

It is intended to develop on similar lines the use of coke for road transport, light locomotives, air compressors, small marine craft, small electric lighting installations, etc.

CANADIAN STATISTICS OF NON-FERROUS SMELTING AND REFINING INDUSTRY, 1928.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner of Canada in London a report of the non-ferrous smelting and refining industry in Canada, giving figures for the year 1928. The development of mining industries in the Dominion has been followed by the establishment of concentrating, smelting and refining plants for various metallic ores, and these plants now constitute a very important industry in the Dominion. The smelting and refining industries include the reduction of cobalt-silver, nickel-copper, copper-gold-sislsver, silver-lead-zinc and lead ores produced in Canada, as well as of imported bauxite from which aluminium is made in Canadian plants.

During the past year the Aluminium Company of Canada imported bauxite ores and alumina, producing ingot aluminium therefrom at their plants at Arvida and Shawinigan Falls, Quebec.

The Horne Copper Corporation began operations on December 16, 1927, and its smelter in the Rouyn district at Noranda, Quebec, which ran continuously throughout the year, produced blister copper from the ores of the Horne Mine and other properties.

The number of companies now engaged in non-ferrous smelting and refining operations is eight, plants established numbering 10, capitalised at $120,085,742. These plants employ 7,526 persons whose wages and salaries aggregate $12,228,788. The estimated cost of ores treated during the year was $33,260,225, the value of the smelter products $94,341,702 representing net value added by smelting amounting to $61,081,477.

MANITOBA MINING NEWS.

The Manitoba *Mining News Letter* dated May 31, issued by the Industrial Development Board of Manitoba at Winnipeg, in describing progress in northern Manitoba, mentions that a progress report will shortly be issued by Manitoba Basin Mines, covering operations from the inception of the Company in March, 1928, to May 1, 1929. Principal work has been done on the Company's herb Lake group where diamond drilling has been under way for some time. Approximately 4,000 feet of drilling has been completed in eight holes. Diamond drilling will be commenced at an early date on other holdings of the Company. The Cold Lake group of claims has been surveyed and at

Rottenstone Lake surface work is being done of 50 claims. It is announced that Ventures, Ltd., will start drilling on the O.K. group at Gross Lake early this summer. A diamond drill is already on the property, having recently been moved from the Oxford Lake property of the Company.

In central Manitoba, at the property of Central Manitoba Mines, Ltd., diamond drilling on the main shaft from the 520 foot level is now under way exploring the lower levels of the property. On the Tene 6 claim to the east, underground work is progressing on the 140 and 250 foot levels and an ore dump is being accumulated. All equipment for the aerial tramway to connect this end of the property is now at the camp and will be set up this summer. The Rogers shaft, on a vein which parallels the Tene 6 about 500 feet to the south is being widened at the mouth in readiness for the installation of hoisting machinery which is now in readiness at the camp. During March, 4,815 tons of ores were milled, from which $99,862.19 in bullion was recovered. The recovery averaged $10.35 per ton and the tailings loss for the month averaged 38 cents.

According to information received from the consulting engineers of Gem Lake Mines, the test shipment of three tons of ore from the No. 2 ore body on the 250-foot level of this property, which was recently made to the Mines Branch at Ottawa, yielded $66.97 in gold per ton. The Mines Branch has advised that they are ready to proceed with the tests as to the most suitable milling process to employ in the treatment of this ore.

In south eastern Manitoba, the engineer-in-charge of development work on the property of Jack Nutt Mines, Ltd., reports that work is being principally concentrated on the Bernic Lake property, where a two compartment vertical shaft has been sunk 80 feet. The Company plans to carr-- this shaft down to the 125-foot level where a cross-cut will be driven to intersect the vein and some lateral work done. If indications are favourable at this point, the shaft will be carried down to the 300-foot level with lateral work done on each level. A metallurgical plant with an approximate capacity of ten tons is being erected for experimental purposes where mill runs will be tested in a practical way. At present 40 men are employed on the property. Surface work is also being carried out on the Rush and Bird groups of the Company.

Work has now commenced on the Bird, Algonquin and Chinnok groups of the Bear River Copper Company.

Announcement has been made of the formation of the Shatford Basin Mines, Ltd. The Company has 25 claims, approximately 1,250 acres, in the Shatford, Bernic and Birse Lakes and Bird River tin area.

During the year ended May 1, staking in Manitoba has been particularly confined to the Bird River, Bear River and Oxford Lake districts. 3,246 claims were recorded in the Province during the period May 1, 1928 and May 1, 1929, as compared with 1,893 in the corresponding period of 1927 and 1928. During April of this year, 497 claims were recorded.

SILVER PRODUCTION IN CANADA.

The Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics at Ottawa has just issued finally revised statistics on the production of silver in Canada during 1928. According to the Report, there was a production of 21,936,407 fine ounces which, valued at the average price for the year, 58.176 cents. per fine ounce, was worth $12,761,725 as compared with the 1927 output of 22,736,698 fine ounces valued at $12,816,677 when the price of silver averaged 56.37 cents. per fine ounce.

A small quantity of silver was produced in association with gold in the Provinces of Nova Scotia, Manitoba, and Alberta. The Quebec output of 908,959 fine ounces was contained in silverl-lead-zinc concentrates and copper concentrates exported and in blister copper made by the Noranda smelter.

Ontario produced 7,242,601 fine ounces, 82 per cent. of which was in the form of bullion; the remainder was contained in concentrates exported, in gold bullion produced from gold mines, and in the nickel-copper ores of the Sudbury district.

British Columbia's output of 10,948,367 fine ounces was slightly less than in 1927, the record year for this Province. Small amounts were recovered in the refining of alluvial gold and gold bullion, but the Sullivan mine and the Premier mine were responsible for the greater part of the output. Silver was also recovered from the copper ores which were exported for treatment in foreign smelters and from blister copper made at the Trail and Granby smelters.

Yukon production at 2,889,633 fine ounces consisted of 7,676 fine ounces contained in gold taken from placer diggings and 2,881,957 fine ounces contained in ores and concentrates exported to foreign smelters.

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NEXT WEEK.

Index Double Number.

The Index to Vol. 138 (Jan. to June, 1929) will be published next week. The price of the Index Number will be 1/-, by post 1/1.

NOTICES OF BOOKS.

Physical Chemistry. By J. B. FIRTH, D.Sc., F.I.C. Pp. 292. London: W. B. Clive, University Tutorial Press, High St., New Oxford St. W.C. 1929. Price 5s. 6d.

The fundamentals of physical chemistry have now entered so widely into the teaching of both physics and chemistry that it is essential for science students to acquire a knowledge of the principles of the subject at a much earlier stage than was formerly recognised. The present work is intended to meet the needs of students reading for such examinations as the London University Intermediate Science and those of other universities and examining bodies.

The general laws, atomic theory, Van der Waal's equation and the properties of Gases and liquids are considered in the early chapters in a very lucid manner. The phase rule, thermochemistry, catalysis, electrochemistry, the colloidal state and radioactivity are then discussed, in the nineteen chapters composing this sound textbook. In the chapter on hydrogen ion concentration a useful table of indicators is given with the pH zone of the colour change. Again the current usage of the term "colloid" differs somewhat from the sense in which Graham first used it and the author has evidently taken considerable care to explain that it now refers to a "state" into which most substances may be converted by suitable treatment. The latest work on the subject has been presented in a clear and interesting manner, thus being eminently suitable for students.

J. G. F. DRUCE.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

22,456.—(Allgemeine Ges fur Chemische Industrie Ges.).—Refining hydrocarbons. July 22.

22,508.—Bouverie, S. Pleydell & Cheesman, T.—Treatment of tar, &c. products. July 22.

22,779.—Dreyfus, H.—Synthetic chemical manufactures. July 24.

22,946.—Grouchkine. L. — *Production of superphosphates.* July 26.

22,417.—Howes, D. A.—Treatment of light hydrcarbons and kerosene. July 22.

Specifications Published.

315,892.—I. G. Farbenindustrie Akt.—Ges. Manufacture and production of moncarboxylic acids.

293,015.—Deutsche Hydrier Werke Akt.—Ges.—Method of carrying-out biochemical processes.

Abstract Published.

313,115.—Liquid fuel. Schanzer, S., (trading as Wernicke & Beyer), 41, Rubensstrasse, Cologne, Germany.

Motor spirit contains a solution of hydroquinone in mineral oil. If the mineral oil boils at over 200° C. the hydroquinone is first dissolved in alcohol, benzole, a mixture thereof, of other solvent, and then added thereto. In an example, to 1 kilogram of petrol there are added 10 grams of hydroquinone dissolved in a mixture of 75 grams of benzole, 50 grams of alcohol, and 365 grams of mineral oil of B.P. 241° C. and *0.931 S.G.*

The Latest TRADE MARKS

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WEMCOL.

503,514.—A chemical substance used for sanitary purposes.—Edgar William Terry, trading as The Wembley Chemical Company, "Mayo", Selsmore Avenue, Hayling Island, Hampshire. July 31st.

IGEFA.

503,261.—All goods in class 2 which includes chemical substances used in horticultural, agricultural, veterinary and sanitary purposes.—I. G. Farbeindustrie Aktiengesellshaft, Mainzerlandstrasse, 28, Frankfort-on-Main, Germany. July 31st.

FIBROTECT.

503,342.—All goods in class 1 which includes chemical substances used in manufactures, photography, philosophical research and anti-corrosives.—Berry, Wiggins & Co., Ltd., Tensulam House, Water Lane, Stratford, London, E15. July 31st.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.— SOUTH AFRICA, 1929.

THE RELATION OF ORGANIC CHEMISTRY TO BIOLOGY.

Address by PROFESSOR GEORGE BARGER, M.A., D.Sc., F.R.S., President of Section B (Chemistry). July 23, 1929.

(*Continued from page* 100.)

Even this very considerable expenditure of organic chemical effort did not absolutely settle the matter, for the Bz methyltryptophane did not yield any kynurenic acid either. Robson found however, that 6-methylkynurenic acid passes through the body unchanged, whereas 8-methylkynurenic acid is completely burnt. It is therefore likely that it is formed from Bz-3. methyltryptophane as a transitory intermediate product, for if 6-methylkynurenic acid were formed, the latter would resist oxidation. Robson concluded therefore, that the single nitrogen atom of kynurenic acid is the one from the side chain of tryptophane (Theory II). Ellinger and Matsuoka, in 1920, after obtaining kynurenic acid from indole pyruvic acid, concluded that the pyrrole ring is indeed opened up, but that its nitrogen atom ultimately survives in kynurenic acid (Theory I). The weakness in the latter's reasoning is that indole pyruvic acid might conceivably be converted in the body into tryptophane, and may not yield kynurenic acid directly.

The example of kynurenic acid will serve to show that there is scope for the application of organic chemistry to the problems of intermediate metabolism, and also the difficulties involved in drawing definite conclusions.

The first stage in the degradation of fatty acids and of amino-acids seems pretty well established, and analogies *in vitro* have been found. Other problems are more obscure. Why is the benzene nucleus in phenylalanine oxidised, but not that in benzoic acid? And what is the mechanism in the former case? Why is p-hydroxyphenyl pyruvic acid easily oxidised, and the corresponding lactic acid not? Why is d-phenylglycine easily oxidised and l-phenylglycine excreted almost unchanged? Altogether the processes by which organic substances are burnt to carbon dioxide and water, by atmospheric molecular oxygen, at a low temperature, are still very puzzling, although Dakin, Hopkins, Knoop, Warburg, Wieland, and others have done much towards their elucidation. In the study of the chemical processes, as in that of the chemical constituents of living organisms, there is much scope for the application of organic chemistry, and in addition, physical chemistry requires to be utilised.

I have endeavoured, by the mention of the above examples, to indicate the importance of organic chemistry both to descriptive and dynamic biochemistry, and thus to physiology. This is its main field of application to biological science, but there are others. There is no reason why an animal or a plant should be recognised entirely by its morphological characters, but systematists, not being chemists, are naturally apt to rely on what they can see, rather than what they can test for. It is very rarely that chemical characteristics are mentioned, although most flora's refer to the odour of trimethylamine in the Stinking Goosefoot (*Chenopodium vulvaria*) and that of sulphide oil in *Sisymbrium Alliaria*. With micro-organisms it is different. The bacteriologist cannot always distinguish one bacillus from another merely by looking at it, nor even by staining it. He has to grow it in a variety of sugar solutions, and see whether it attacks these. In order to differentiate typhoid from paratyphoid, he grows them in dulcitol solution, with neutral red, which may or may not be changed owing to the production of an organic acid from the sugar. In order to encourage an organism to grow, which is normally swamped by other species, he may use specific disinfectants, such as brilliant green and other dyes. The relation between microbiology and organic chemistry is beneficial to both. The list of organic substances which can be produced by micro-organisms on an industrial scale, mostly from carbohydrates, is a growing one. During the world war the water power of Switerland could temporarily compete with the fermentation industry in producing alcohol (*via* calcium carbide), but later the potato re asserted its superiority. The same war period saw the industrial production of glycerol by yeast, and the production of acetone and butyl alcohol by bacteria, both from carbohydrates. The peculiar metabolism of many micro-organisms still awaits utilisation.

The group of plants in which chemical constituents have been most widely used in classification is that of the Lichens. Lichenologists have long used chemical reactions with potassium hydroxide, bleaching powder and ferric chloride, for the identification of

species and genera, and some 200 characteristic benzene derivatives have been isolated. In Phanerograms the taxonomic value of the chemical constituents is slight. Substances of obvious metabolic significance may extend throughout a whole order; thus inulin occurs as reserve carbohydrate in all divisions of the Compositae.

Probably the most extensive attempt to use chemical constituents for botanical classification has been made by R. T. Baker and H. G .Smith, in the case of the Australian genus *Eucalyptus* with about 200 species : the essential oils from well over half of these have been examined. Baker and Smith trace a relation between the venation of the mature leaves and the composition of their essential oil. The genus is thus divided into fairly well-marked groups, and it is possible to suggest the probable constituents of the oil of a given species by examining the venation of the leaves, and, conversely, by chemical investigation of the oil to gain a clue to the species. Maiden, the botanical expert on *Eucalyptus*, has not always agreed with the classification of the chemists, but upon occasion has discovered morphological differences after a delimitation of species had been proposed on chemical grounds.

Among characteristic plant constituents perhaps most chemical labour has been expended in the alkaloids ,which are usually restricted to a particular order, genus, or species. An increased knowledge of the various amino-acids of protein, and a study of many alkaloids has in many cases indicated a plausible way in which the alkaloids, particularly those containing an isoquinoline nucleus, may arise from aromatic amino-acids, by decarboxylation and ring formation from the side chain, but we are still very much in the dark as to the physiological importance of alkaloids to the plant. Nor is it easy to trace a connection between chemical strueture and botanical classification. Thus within the same genus differently constituted alkaloids may occur, or certain species may contain an alkaloid and others not. Some thirty-five species of *Cytisus* were examined by Plugge and Rauwerda; about half contain cystisine, half do not. Yet cytisine occurs in *Ulex*, *Genista*, and several other genera of Leguminosae. It may even happen that in one and the same species the alkaloids change according to the age of the plant. Thus *Papaver orientale* contains during the vegetative period only thebaine, which is almost entirely replaced by isothebaine after the death of the aerial parts of the plant. Obviously it is very difficult under these circumstances to draw conclusions as to a taxonomic relationship. The only wide generalisation which seems to me justified is that the large group of isoquinoline alkaloids are characteristic of the rather primitive cohort, Ranales, and the related order, Papaveraceae.

The main biological interest of alkaloids is not botanical, in their distribution, but pharmacological, in their action. This leads to a mention of the great developments in synthetic drugs, due to organic chemistry. In particular there is great scope for the organic chemist in chemotherapy, the combating of general infections of the host by synthetic drugs. The production of salvarsan which had made such a great change to the treatment of syphilis and other protozoal diseases and the subsequent introduction of germanin (or Bayer 205) in the treatment of sleeping sickness indicate great possibilities of applying organic chemistry to this particular department of medicine, and constitute a link between workers in very different fields.

I have called attention to the many points of contact between organic chemistry and biology in the past and present and if finally I am permitted to draw a conclusion it would be an educational one. I hold it to be desirable that biologists should have at least an elementary knowledge of organic chemistry, in spite of the difficulties imposed by ever-increasing specialisation in science. These difficulties are particularly felt in apportioning the time available for medical education among the many subjects of a crowded curriculum, and may to some extent be met by a careful consideration. of what is really useful. The chemical training of the physician (and of the biologist) should not be identical with the preliminary training of the professional chemist, although it still is so in many universities. In order to save time much elementary chemistry, particularly inorganic, must be abandoned, thus making room for those aspects of the subject which have biological applications. This differentiation between the chemical needs of various groups of students requires special courses, and teachers who have a sympathetic understanding of the peculiar needs of their students, medical and biological. After writing this sentence, I found a similar one in last year's address to Section I at Glasgow, by Professor Lovatt Evans. " The solution to the difficulty [of the medical curriculum] lies, in my opinion, in the exercise of a sympathetic understanding on the

part of specialist teachers of the difficulties of the student and a proper perspective of the relation of his own subject to the requirements of the curriculum as a whole." I need hardly say I agree entirely with this. I also welcome another sentence from the same address : " It is significant that at the present time a steadily increasing number of young highly trained organic chemists consider it worth their while to turn to biochemistry; their welcome entry into our ranks gives us fresh hope and faith in our future, as well as in theirs."

Professor Lovatt Evans also discusses the question, " much debated in private, though little in public," whether a biochemist should be primarily a chemist or a biologist. He sees no reason why the biochemist should not be both. I imagine the biochemist cannot be both equally from the outset, but he may aspire to be both, or alternatively, biochemists can be made both out of chemists and out of biologists. Once more I heartily agree with Professor Lovatt Evans when he writes : " If he must have one label, it is better that of the chemist, provided always that the biochemist works in the closest possible association with the physiologist. This is most essential if both are not to be deprived of much valuable interchange of ideas and, on a lower plane, of materials and apparatus. In fact, I am convinced that within the limits of administrative possibility, the greater the variety of workers brought together the better the results."

EAST INDIAN COPALS AND DAMARS.

By A. F. Suter.

Paper read before the Royal Society of Arts on February 27. Mr. J. G. Watson, Forestry Economist of the Forestry Department, Federated Malay States, presided.

Resins are, with one important exception, of vegetable origin, formed by the oxydisation of natural or artificially stimulated exudations from certain plants. The exception referred to is shellac, which, instead of exuding from the plant, has to pass through the body of an insect attached to the plant.

The *resins* are, therefore, closely allied to such botanical products as latexes, vegetable waxes, gums and wood oil; in fact, there are quite a number of intermediate products, containing two or more of these exudations in mixture. A very large number of plants of various natural orders produce resins. These differ in their characteristics comparatively little, but not all of them have attained economic value.

The *distribution* of resiniferous plants is world-wide, extending in both hemispheres from the equator far down into the temperate zones. Copals and damars are found right through the Far East in a broad belt along the equator and again through the African continent. In the southern hemisphere, New Zealand, between 40 and 50 degrees latitude, is the home of the Kaurie resin, and similar copals occur in Northern South America, Brazil and along the Andes to points much further south. In the northern hemisphere, resins are collected largely round the Mediterranean and Central Europe, while the pine forests of North America are responsible for enormous quantities of oleo-resins.

Of resins known to commerce, the two chief groups are the *copals* and the *damars*. The resinous products of the various pines are grouped by themselves, since they mostly do not come into commerce in their raw state, but are distilled into spirit of turpentine and rosin at the source of production. Among the *minor resins* are best known sandarac from Morocco and Southern Australia; mastic from Chios and the Levant generally; red and yellow acroydes from Southern Australia, and benzoin from the East and West Indies.

The grouping of the major resins into copal on the one hand and damar on the other, is somewhat arbitrary but quite useful, being based upon the difference of their physical characteristics. It is with these two groups that we shall chiefly concern ourselves to-night.

The copals of commerce comprise the following resins, given with their botanical origin and chief country of collection :—

Macassar, or Manilla Copal (*Agathis alba Foxw*), Dutch East Indies.

Kaurie Copal (*Agathis robusta*) New Zealand.

Congo Copal (*Copaifera* and *Trachylobium spp.*), Belgian Congo.

Zanzibar or Lindi Copal (*Tract. Hornimanniana*), Zanzibar, Madagascar and East Coast.

Sierra Leone Copal (*Copaifera Guibourtiana*), West Coast Africa.

Angola (Benguela) Copal (*Daniellia* species), West Coast Africa.

Demerara Copal (*Hymenea Courbaril*), (Locust tree), West Indies and Central America.

Of these resiniferous trees, the *Agathis alba* and *A. robusta* belong to the order of

the Coniferæ, all others to the order Leguminoseæ, sub-order Ceasalpiniaceæ.

The damar producing trees all belong, as far as is known, to the rich and varied natural order of the Dipterocarpaceæ, chiefly the genera *Shorea*, *Hopea*, *Balanocarpus*, *Vatica* and *Vateria*. They are all indigenous to the tropical belt from Ceylon eastward to New Guinea and are collected very largely in Sumatra, Bornea and the F.M.S.

The name copal, which is Mexican for resin, is unknown to the natives in the East. Both groups, damar and copal, are called damar, the Malay name for resin or a torch made of resin.

COPALS.

Of the various copals known, the one to concern us is the *Macassar or Manilla Copal.*

This type of copal has its origin in one single plant, the *Agathis alba*, and it occurs most frequently in the Dutch East Indies, in Celebes, the Moluccas, Borneo, Sumatra and New Guinea. The tree also occurs largely in the Philippines, and in the Malay Peninsula, where the resin is, however, not collected. The tree does not exist in Ceylon or British East India, nor further west in the same latitudes.

The Resin.—Copal is a natural exudation from the bark of the *Agathis alba* at places where the latter has been injured, by design or accident. Resinosis, that is, the process of the production and exudation of the resin, takes place only in the bark. When a piece of bark is removed from the trunk, innumerable tiny drops of a sticky liquid begin to exude at once. In colour these are very pale, some clear and some opaque. In a few days they have grown to long streaks down and below the area from which the bark has been removed, and have hardened on contact with the air to such an extent that they can be removed quite easily. This polymerisation to a hard substance naturally chokes the wound and stops the flow, but when the resin is removed and the wound scraped afresh, the flow starts again.

What purpose the resin fulfils in the process of vegetation seems a mystery. In my opinion the sole purpose of the resin is one of protection against damage of any kind. in which case it would be of pathogenetic origin.

Foxworthy distinctly states that "occasionally pieces very densely impregnated with resin are found, these being nearly always small, very heavy and very dark in colour." Van de Koppel, on the other hand, asserts that during the whole of his stay in the copal forests of Malili he had never found anyres in ducts in the wood, either sap or heart. I mention this because, the resin never being found in the normal process of vegetation, it is specially manufactured in times of need, *i.e.*, protection to the tree. It may be as likely, therefore, to occur in the sapwood immediately below the cambium as in the inner bark, provided the damage to the tree has been sufficiently deep to provoke this pathogenetic process.

The various kinds of copal of the Macassar type known in trade are :—

(*a*) Hard or fossil copal, of unknown but often very great age, and very hard.
(*b*) Half-hard copal, less hard and much younger.
(*c*) Soft or spirit soluble copal.

Type (*a*) is found either in the crotches of branches in old trees or else dug from the ground at the foot of old trees or where trees at one time existed. Types (*b*) and (*c*) are of recent origin and are obtained by the removal of portions of the bark of living trees.

In the forests of Malili, where the tapping of copal trees has now been practised as a well-regulated industry for years, the method of tapping the trees has become very uniform, owing to strict supervision by forestry officials. These foresters have to enforce the stringent rules and regulations in order to prevent the heavy over-tapping which took place in earlier years and was the direct reason for the extensive mortality among the trees.

In Malili there are reckoned to be about 200,000 copal trees spread over perhaps 2,500 square miles, and leased for exploitation to about 1,500 natives. The trees are leased by the Government to the natives in batches of 50 to 200. The native undertakes to tap the trees according to the regulations in force, any serious transgression or the death of trees through over-rapping being punished by forfeiture of the lease or even imprisonment.

Yield of Trees.—Up to recent years very erroneous opinions of the yield of the copal trees existed. These were based probably on native statements. Since, in Malili, trees are now farmed out in definite numbers of 50, 100, and 200 to each tapper, much more reliable figures have been obtained lately, but even here very large variations have been observed, namely, between 8 and 40 picols per 100 trees per annum. The highest yields have been shown in the area between the Matano and Toewoeti lakes, by trees with a very large diameter and growing in very rich soil. The lowest

yields are given by trees in very arid soil and of smaller diameter. Van de Koppel gives the figures of 12 kg. per tree as an average in the Malili district.

Preparation and Sorting.—We have seen that the supplies of copal are received at the centre of ultimate export in a very mixed condition. Not only are soft and half hard grades always caked together into a block, but at times there are also found in the block pieces of fossil copal which have accidentally been found in the forest. It is, therefore, necessary to separate the various grades.

Four fundamental considerations have to be observed in the grading of copal; firstly, hardness; secondly, colour; thirdly, purity (absence of extraneous impurities); and fou.thly, size. Machinery is never employed. It is, however, difficult to induce any of the sorters to change their method, their movements becoming completely automatic once they think they have understood the meaning of the work. The children are taught sorting not so much by the overseer as by their mothers. Very early they detach their mental processes from the work in hand, being swift enough with their fingers, but miles away in mind. This fact may explain the apparent excess of labour expended on this operation. I have observed that a greatly superior number of grades is sorted by the women than ultimately appears in the European markets. These grades are later re-incorporated into a certain definite numher of standard grades and then packed in cases, baskets, or bags for export.

The *hard* copals, Malay name Boea, are sorted according to their size into five grades from A to E, although various colour standards are also in existence. The preparation for export in their case simply consists of removing the weathered crust by a sharp knife.

The *half hard* copal, Malay name Loba, is also assorted into five grades, A. to E, according to size, but variations in colour are responsible for a number more.

The *soft* copals, Malay name Melengket, are sorted in the first instance according to their purity, as they usually contain more or less wood, bark or other impurities. The assortments originally were :—

1, Free from wood; 2, very moderate amount of wood; 3, fair amount of wood.

But the distinction between the three grades was never sharp enough.

Use of Copals in Modern Industry.—Copals were up to a recent period exclusively employed for the manufacture of varnishes. The soft copals being completely or nearly completely soluble in cold alcohol, are employed for the making of spirit varnishes without further preparation. The hard and half-hard copals require to be fluxed, that is, melted and cooked for some time before they become soluble in turpentine, and, by this means, in drying oils.

Kaurie copal finds extensive employment in the manufacture of linoleum, at least the inferior grades, but it is the half-hard Macassar copals which have come into very large demand during the last decade. They are used for all sorts of pressed and stamped articles in the form of a binder; very often in conjunction with or instead of shellac, with which they share several physical properties. Their di-electric properties, however, are much inferior to those o fshellac.

Synthetic resins are now coming into vogue and it looks as if these forests products were losing favour in some directions, but I believe that, given accurate standardisation of the product, they will be capable of withstanding such competition. However, this is the age of the chemist, so that many of the raw products of nature will depreciate in value in proportion to the usefulness of a synthetic competitor.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

(*Continued from page 95.*)

To turn to the subject of safety, I wish to pay a tribute to the very valuahle work which has been and is being done by the Works Technical Committee under the Chairmanship of our Treasurer, Dr. E. F. Armstrong. Part I of the Model Safety Rules has recently been issued in provisional form; we have received many letters of appreciation from our members, while there have been glowing eulogies in the Press. There has consequently been a big demand for copies and nearly 800 have already been distributed. The object of Part I. was to bring together, in a clear and concise form, the various principles which require consideration in connection with various types of dangerous manufacture in order that essential precautions may not be inadvertently overlooked in commencing some new manufacture. Members who have their own safety methods already very fully developed have expressed their appreciation from the ponit of view that the issue and discussion of the rules have led to a careful review of their own precautionary measures and have

revealed a number of points worth consideration. The preparation of Part II is now actively in hand, but will of necessity take some time to complete as information has to be collected and correlated from all available sources at home and abroad. The object of Part II is to amplify Part I, and to bring together in the form of a text book convenient for everyday use, the large amount of valuable information regarding safety measures in chemical works which is either available in scattered publications and reports, or which, while in the possession of individual manufacturers or of the Government Departments concerned, remains as yet unpublished. We hope to produce a publication of great value to the chemical industry and to set an example to other industries. We feel that it is desirable in every way for the chemical industry to take a lead in drawing up an adequate code of safety precautions of its own and ensuring that they are fully applied where any danger exists.

Closely connected with this is a new venture which was undertaken on the recommendation of the Works Technical Committee, namely the issue of Safety Circulars which consist of information which comes to hand from time to time in connection with accidents or their prevention in chemical works. These circulars appear to be supplying a definite want, since there has been a large demand for them from our members and from those of our affiliated associations. The normal issue of each circular is about 900 copies. The co-operation of all members in this safety work is urgently required, and we would ask you to submit to the Association any information you may have or which may come to your knowledge which would be useful in the preparation of Part II of our Model Safety Rules and of new Safety Circulars. The Council wishes to express its sincere appreciation of the valuable help which the Home Office is giving in this connection in placing its experience at the disposal of the Works Technical Committee. I should like to say in that connection also, that if we are going to have a new Factories Bill it is very important that we should have these Model Safety Rules applied, so that we make sure that the new Bill follows the lines that we recommend with regard to the chemical industry. That we have to impress on the Department.

I have no special comments to make regarding the useful work of standardisation which is going on in connection with tests for tar products, or on the subject of the Fine Chemical, Dyestuff and Wood Distillation Industries. The ne wscheme of cooperation between the Chemotherapy Committee of the Medical Research Council and the Association will, I feel sure, be of benefit to both sides. The work of the Resistant Metals Committee is proceeding along satisfactory lines, but there is still a great deal to do and the maintenance of the closest co-operation between all parties concerned will be essential for the satisfactory solution of the difficult but very important problems involved.

The very important work of our Patents Committee, under the Chairmanship of Dr. Ree, requires special mention. This Committee was resuscitated as a result of the suggestion made by our Treasurer at our last Annual Meeting, and has been actively engaged since the end of last year in reviewing the existing British Patent legislation primarily from the point of view of the chemical industry. This work was undertaken before there was any indication that the Government intended to move in the matter. Now that the Board of Trade has appointed a strong and representative Committee to investigate the whole subject, it is essential that the defects in our Patent system, from which the chemical industry has been sucering, should be brought to its notice in an authoritative manner. We feel that it is of the utmost importance that a single agreed Memorandum should be submitted on behalf of all the bodies connected with chemistry and the chemical industry, rather than that each should submit a report of its own with perhaps differences on points of detail. Arrangements to this end have been made through the Federal Council and the Patents Committee will be the body responsible for drawing up the Memorandum to represent the views of chemistry, and to which the other societies will send such proposals as they wish to make. In this way we hope to ensure that chemistry will speak with one voice on the subject of our Patent legislation, and that as a result we may be able to secure the reforms of which we are in need. I think it is extremely satisfactory that we started the review of the Patent legislation in time and that we have been selected as the body to draw up the agreed report.

I have nothing to add to what has been said in the Report regarding Contracts, Cooperation in Industry, Industry and Trade and River Pollution. I have already referred to the Final Report of the Balfour Committee and I would like to suggest that all members should make a careful study of

this valuable document, particularly Sections VI and VIII, which deal respectively with factors in competitive efficiency such as rationalisation, standardisation and research and with customs policy in relation to competitive power and subjects such as safeguarding and import prohibitions and restrictions. The Council would welcome suggestions for constructive action arising out of this Report.

(*To be continued.*)

SCIENTIFIC METHODS FOR SWIMMING BATHS.

An Important New Publication.

By A Well-Known Engineer.

Continuous sterilisation and general purification of swimming baths, using a measured trace of chlorine gas, a fine example of chemical engineering, is now rapidly becoming the standard practice, and has rendered obsolete the ordinary methods of filling up a bath with fresh water and emptying it out again, when dirty and swarming with bacteria. Under the latter conditions, apart from colds, sore throats, bad eyes, paratyphoid, and influenza, much more serious diseases may be conveyed, such as diphtheria, tuberculosis, and enteric fever, since the water is often contaminated in a few hours, especially as the natural resistance of the body is diminished by the cooling effect.

The Paterson Engineering Company, Ltd., of London, have now issued a new and much enlarged edition of the publication, *The Purification of Swimming Bath Water*," and this gives a lucid description of the whole system. It will be remembered the exact series of operations, in the following order, consists of straining, treatment with sulphate of alumina and soda ash coagulent, to separate all the colouring matter, using chemical injection pumps along with storage tanks, filtration through standard closed pressure sand filters, fitted with compressed air cleaning, aeration to give the sparkling condition of fresh water, also by compressed air, generally using an electric driven blower, and continuous sterilisation with chlorine gas by the "Chloronome" apparatus using about one part of chlorine per two million parts of water. Also a Calorifier is included to maintain the temperature of the water at about 72° F. in summer and 78° F. in winter. The circulating pump, of the centrifugal type, is either electric or steam driven, and generally the capacity is sufficient to give one complete circulation of the whole of the bath water about every 3 or 4 hours. The strainer for eliminating any large objects in a cast iron cylinder with a removable sylindrical gauze, and as regards sulphate of alumina and soda ash these are stored in slate tanks operating in conjunction with small feed pumps of the plunger type for the continuous supply of the reagents to the water. The standard "Paterson" closed pressure sand filter is made in standard sizes up to 9 feet diameter, having a complete battery of control valves, using a deep bed of quartz sand, the compressed air for cleaning beinb supplied from an electric driven pump, steam injector, or other suitable apparatus. Also the aerator is a vertical steel cylinder, the air entering at the top and passing up through the descending water so as to give an intimate contact, while the arrangement includes a special vent pipe for the discharge of entrapped gases.

The "Chloronome" apparatus for the continuous addition of a measured trace of chlorine gas to the water, with accurate control of the amount by means of a single valve, is now well known, being coupled up to standard steel cylinders each containing about 70 lbs. of chlorine. The arrangement includes pressure reducing valves, and a glazed earthenware absorption tower so that the chlorine is dissolved first in a very small volume of water, which solution then passes out into the main bulk so as to ensure rapid and uniform chlorination. Finally the calorifier or reheater using steam, is of the vertical multi-tube type. A large number of Paterson bath plants on these advanced lines are now at work, some of the latest installations being Beckenham U.D.C. (Kent), Windsor Baths (Bradford Corporation), Barking U.D.C. (London), Wolverhampton Corporation, Wood Green U.D.C. (London), Hoxton (Metropolitan Borough of Shoreditch), Greenwich, and Guildford (Kent). For example, at Beckenham the first-class bath is 100 feet by 30 feet, holding 100,000 gallons and the second-class bath 80 feet by 30 feet, of 67,000 gallons, the rate of circulation being 25,000 gallons per hour, with electric drive throughout, and three 8 feet diameter closed pressure sand filters.

GENERAL NOTES.

WHOLESALE PRICES IN JULY.

Board of Trade Index Number.

As measured at the Board of Trade, wholesale prices were higher in July than in June by 1.3 per cent., the index numbers for the two months being 82.7 and 81.6 respectively (1924 = 100). Food became dearer by an average of 3.7 per cent., while industrial materials showed no change on balance as compared with the preceding month. The averages for cereals, meat and fish, and miscellaneous foods rose by 8.9, 0.5 and 2.0 respectively. Among industrial materials 0.2 and 2.0 per cent. respectively. Among industrial materials the averages for iron and steel and for other " other " textile materials cheapened by an average of 0.9 and 1.0 per cent. respectively, while miscellaneous materials became dearer by 1.8 per cent.

THE WOOD DISTILLATES AND EXTRACTS INDUSTRY IN CANADA.

According to figures just published by the Dominion Bureau of Statistics at Ottawa, the production in 1928 of wood distillates and wood extracts reached a total value of $1,645,009, or 4 per cent. in excess of the 1927 total. The group of 7 establishments includes 4 distillation plants in Ontario and 1 distillery, 1 refinery and 1 turpentine works in Quebec.

Capital employed by these plants in 1928 was reported at $1,884,985; the average number of employees was 217; salaries and wages totalled $244,488; materials cost $826,477 at the works and the value added by manufacturing was $818,582.

Charcoal, methyl hydrate, acetate of lime, acetic acid, formaldehyde, wood creosote and turpentine were among the products of this industry.

SODA ASH MINING INDUSTRY TO BE DEVELOPED IN BRITISH COLUMBIA.

According to a report received from Vancouver, the British Columbia Chemical Company, Ltd., is shortly to commence large-scale mining of soda ash from deposits near Clinton, B.C. A plant to cost about $50,000 is being installed at Last Chance Lake, near Beaver Dam, about twenty miles north of Clinton, for the mining of soda from the bottom of the lake.

Soda ash or sodium carbonate is most largely used in the manufacture of glass. The possibility that a considerable market for the deposits of soda ash in the shallow lakes of the Clinton district may develop is indicated in the recent announcement that a glass plant to manufacture bottles would be established at New Westminster, British Columbia. Besides its use in glass manufacture, soda ash is largely used in the pulp and paper industries and in the manufacture of soaps and washing compounds, and in many other industries. Government statistics show that since 1921 small amounts of the natural sodium carbonate have been shipped from the Clinton district, the only commercial production in Canada.

THE SITUATION OF COTTON CROPS IN THE PRINCIPAL COUNTRIES OF PRODUCTION.

The first official estimate of the area sown with cotton in the United States, published on July 8, is slightly smaller than was anticipated on the basis of private estimates. Although the increase compared with the preceding season is relatively small, 3.2 per cent., yet the crop occupies a very considerable area which amounts to only 800,000 acres less than the maximum reached in 1926-27, when 48,730,000 acres were sown with cotton. The year of maximum area, 1926-27 was also the year of maximum production obtained up to date in the United States; but correspondingly large increases in area, the crop yielded depending upon the yield per acre which in its turn is influenced both by weather conditions and, especially in the case of cotton, b yparasites. Weather conditions, which were rather unfavourable during the first two months owing to the predominance of excessive rains and low temperatures, improved in June, especially durin gthe second half of the month when temperatlres rose appreciably. The development of the plants, which on the whole were rather irregular and backward, recovered somewhat during this period. On the other hand, if the progress of the plants were fairly satisfactory in June, the possibility of damage due to spreading of the boll weevil has increased as the wet and not too hot conditions favoured the propagation of this pest. Information concerning the development of the crops during the first half of July is satisfactory, the progress of the plants being good in all areas of the cotton belt including Texas. Allowing therefore for an eventual increase of damage due to spreading of the boll

situation of the crops at the middle of July could be considered as promising a good yield. In India the monsoon rains were fairly plentiful in June and allowed planting to take place under good conditions. In the Province of Bombay, however, rainfall was not well distributed, being inadequate in some areas and too abundant in others.

In Egypt the crops benefited in June by favourable weather and their development was good. Damage by parasites appeared to be smaller than last year.

In the U.S.S.R. the cotton area appears to be greatly increased and there will be a larger available supply and a better system of distribution of irrigation water.

A congress of Slav Dermatologists was held recently in Warsaw under the presidency of Prof. Krysztalowicz. The opening address was given by Prof. Samberger (Prague), whose lecture concerned "Psoriasis." Among the papers of chemical interest were the following: "The Action of Bismuth in the Coagulation of Blood." By Dr. Mienicki (Wilno). "The Therapeutic Value of Acetyl-arsan." By Dr. Grzyhowski (Warsaw). "Treparsol in the Treatment of Psoriasis," and "Mixtures of Neosalvarsan and Sodium Thiosulphate and Sodium Bromide." By Docent Hubschmann (Prague). "The Use of Glucose for Cutaneous Disorders Accompanying Serious Intoxications." By Dr. Petrácek (Prague).

DISINFECTANT FLUID FOR SOUTH AFRICAN RAILWAYS AND HARBOURS ADMINISTRATION.

His Majesty's Trade Commissioner at Johannesburg (Mr. J. W. Brigden) reports that the South African Railways and Harbours Administration is inviting tenders (Tender No. 1518) to be presented in Johannesburg by the 26th September, 1929, for the supply of approximately 25,800 imperial gallons of disinfectant fluid.

Firms desirous of offering disinfectant fluid of United Kingdom manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London ,S.W.1. Reference Number B.X. 5568 should be quoted.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

The 89th Annual Show will be held at Manchester from Tuesday, July 8, to Saturday, July 12, 1930. Particulars can be obtained from T. B. Turner, Secretary,

DEATH OF SIR RAY LANKESTER.

On August 15 Science lost a popular votary by the death of Sir Ray Lankester, F.R.S., at the age of 82 years. He was in many respects a notable figure. His books were popular, and unquestionably he did a great work in making science understood by the multitude. He graduated at both Oxford and Cambridge, and was elected a Fellow by the Royal Society when under 30 years of age. He filled many important positions in his time, among them :—

Professor of Zoology and Comparative Anatomy at University College, London.

Regius Professor of Natural History at Edinburgh.

Director of the Natural History Department of the British Museum.

Fullerian Professor of Physiology at the Royal Institution.

Founder and President of the Marine Biological Association.

In his earlier days, a travelling scholarship brought him unexpected adventure. He sat for a night on the top of Vesuvius when the volcano was in eruption; and he was once fired on by Italian brigands.

THE WORK OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE.

The meetings of the Permanent Committee of the International Institute of Agriculture have recently been suspended for the Summer Vacation. The Committee has every reason to be well satisfied with the important work accomplished by the Institute, since the last meeting of the General Assembly in October, 1928, partly in connection with the resolutions voted by the Assembly itself and partly as the result of the Committee's own initiative.

As from the beginning of the year the Institute has published, in five editions in the five principal languages, its *International Review of Agriculture*, which is now issued in three distinct monthly parts under the respective titles of the *Monthly Bulletin of Agricultural Science and Practice*, the *Monthly Bulletin of Agricultural Economics and Sociology*, and the *Monthly Crop Report and Agricultural Statistics*. The monthly publication of the *International Bulltin of Plant Protection*, which had been temporarily suspended, was also resumed as from January last. The International Yearbooks

Legislation for the period 1926-29, which are now in the eighteenth year of their existence, will be issued at an early date. A certain number of special monographs have also been distributed, including one dealing with the Legislation on the Trade in Plants and Plant Parts in the various countries and another on the subject of International Agricultural Credit, a question which has been under study at the Institute for more than three years and which it brought to the special notice of the Economic Conference at Geneva.

In the early part of the year, Professor Alessandro Brizi was appointed Secretary General and his expert knowledge has already proved of the highest value to the technical services of the Institute.

Two important international meetings have been held during 1929, the first being the International Diplomatic Conference for Plant Protection, the result of which was the approval by twenty-eight countries of an International Convention, of which the Italian Government is now the Depositary. The second was the meeting of experts, charged with the work of preparation for the International Diplomatic Conference for the Protection of Cheese Descriptions, which is to be held in February, 1930. At the same time the Institute has taken part in the most important congresses, etc., in other countries. Thus it was represented at the second meeting of the Economic Committee of the League of Nations, to which it presented four important statements, while a special delegation was sent to the International Congress of Agriculture at Bucarest. Delegates also attended the International Congress of the trade in Herbs at Venice and Padua and different congresses in France, the Netherlands, Hungary, Switzerland, England and Canada.

Professional and scientific societies are constantly manifesting their high appreciation of the Institute's services. Its palace has already been chosen as the headquarters of the Olive Growers' Federation and it is proposed that the International Federation for Aromatic and Medicinal Plants, now in process of formation, shall also have its headquarters at the Institute.

Special reference should be made to the marked development of the activities of the International Commission of Agricultural Associations, which already includes in its membership two hundred of the most important Agricultural Societies in the world. The Office of the Commission is at the Institute and it publishes a monthly Bulletin of great interest.

The Permanent Committee has decided to call a meeting of the Commission for Tropical and Sub-Tropical Agriculture of the Institute's Scientific Colncil for an early date, and in the meantime a meeting of the Economic Agricultural Committee has been summoned for October next. The members of this Committee are experts of high reputation and the questions on the agenda are of particular importance.

In all probability there will be a resumption during the summer months of the negotiations between the President of the Institute ,Senator de Michelis, and Sir Eric Drummond, General Secretary of the League of Nations. The object o fthese negotiations is to determine the relations which should properly exist between the two Institutions with special regard to the study of the economic problems which have a direct bearing upon agriculture.

IOWA STATE COLLEGE.

The Board of Editors of *Organic Syntheses* (an annual publication of satisfactory methods for the preparation of organic chemicals) has decided to collect, revise and rearrange the preparations described in the first nine volumes in such a way as to make them more suitable for general use in synthetic organic chemistry. All of these preparations are to be published in a single comprehensive volume to be designated as the "Collective Volume—Revision of Volumes I-IX."

In this work of revision the Board would greatly appreciate suggestions in the way of corrections, difficulties in checking, new and improved methods, etc.

LOW TEMPERATURE CARBONISATION.

The Largest Plant in the World Now in Operation.

Characteristic of the new scientific methods with raw coal is that the "K.S.G." low temperature carbonisation plant at New Jersey, U.S.A., has now started up in full running, being the largest installation ever set at work, having a throughput of 520-720 tons of bituminous coal dust and smalls per 24 hours. This is operated by International Combustion Engineering Corporation, who, it will be remembered, along with Coal Oil Extraction, Ltd., of London, control the "K.S.G."

process, and the plant is suplying on long contract a minimum of 3,000,000 cubic feet of town's gas per 24 hours, 535 B.Th.U. per cubic foot, to the Public Service Electric and Gas Company of New Jersey, with normally 4,000,000 cubic feet.

In this case eight standard retorts are included, constructed by the Bethlehem Steel Corporation, of the usual design, being a long rotary, slightly inclined, mechanically continuous, externally heated steel cylinder, 72 feet long and 10 feet diameter, having an inner cylinder 85 feet long and 5 feet 6 inches diameter, which carries the load. The speed is very slow, 1 revolution in 90 seconds, with drive by means of suitable gearing, and the complete weight of the finished steel retort is about 160 tons, the outer drum being made in three sections, the two end sections being ⅞ inch thick, and the middle section 1 inch thick, with all the seams hammer welded under water-gas heating and anneaued. Also each seam is reinforced by means of outer steel bands 2 feet wide and 1½ inch thick, rivetted and welded and the inner drum is on the same lines, but much heavier ,made of 1½ inch plate.

The small coal enters the retort at one end and travels along the inner cylinder during 1-1½ hours, being raised to a temperature of 400°-570° F. (205°-300° C.). Then the charge falls out through small apertures into the outer cylinder, which at this point is the hottest zone, about 925°-1025° F. (495°-550° C.), while at the same time highly superheated steam at 850°-950° F. is blown through the charge to the extent of about 100-200 lbs. per ton of coal. As a result of this very sudden rise in temperature combined with steaming, the plastic material in the case of coking coal does not expand unduly, because of the rapidity of carbonisation, giving therefore a dense, hard, smokeless fuel in mechanically continuous operation. The low temperature carbonisation is completed in another 1-1¼ hours' travel in the outer cylinder, the temperature slowly declining to about 800°-900° F. (430°-485° C.).

Also a certain amount of the low temperature fuel dust and breeze, not over 10 per cent., is blended with the raw coal to prevent the plastic charge sticking, while for heating the setting, producer gas is burnt in a small firebrick combustion chamber, and the resulting flames and hot gases at 2370°-3095° F. (1300°-1700° C.) are diluted, not with air, but with about 50 per cent. of the total combustion gases re-circulated to give approximately 1100°-1290° F. (600°-700° C.) passed round the retort. In this way corrosion and deterioration of the steel cylinder is minimised since no oxygen it present, and all the mixed gases and vapours evolved by the carbonisation pass through a dust extractor, while the hot smokeless fuel is quenched, not by water or steam, but with the aid of cold gas.

The installation at New Jersey includes a large water gas equipment, which normally is used to supply blue water gas, this being mixed with the rich low temperature carbonisation gas to give the minimum of 3,000,000 cubic feet per 24 hours, 525 B.Th.U. per cubic foot, but usually 4,000,000 cubic feet, as stated. In emergency, however, the water gas plant can be operated with a carburetting installation, using heavy oil and producing the desired amount of town's gas direct, independently of the low temperature carbonisation.

There is being used in this installation highly bituminous gas coal dust and smalls, and the average yield per ton is about 3,900 cubic feet of very rich gas (800 B.Th.U. per cubic foot), 4 gallons crude light oil, 30-33 gallons tar, and 14¾ cwt. (73.7 per cent.) solid smokeless fuel with 12 per cent. volatile matter. This corresponds therefore on maximum operation to an output per 24 hours from the complete plant of 2,500,000 cubic feet rich gas, 2,500 gallons crude oil, 19,000 to 21,000 gallons tar, and 470 tons solid smokeless fuel, and the detailed results of this installation will be awaited with the greatest interest.

MANUFACTURES OF NON-METALLIC MINERALS IN CANADA.

STATISTICS FOR 1928.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner of Canada in London a report presenting preliminary summary statistics indicating that the manufactures of the non-metallic minerals in Canada during 1928 reached a total value of$206,016,596; an increase of no less than thirty million dollars as compared with 1927 .

The average value received by the operators in 1928 was $41.16 per ton as compared with $38.65 per ton in the previous year. Asbestos rock mined during 1928 totalled 5,171,000 tons, of which quantity 4,118,044 tons were milled.

The industry includes the operation of 1,169 factories which represented a capital of $290,466,889 and employed 28,615

workers throughout the year. In 1927 only 26,685 people were employed in the plants of this class and production totalled $175,732,594. in value.

Firms in this group are classified into 17 different industries and only 2 of these showed lower output values in 1928 than in the preceding year. Petroleum products advanced 29 per cent. to $88,122,172; coke and gas, 2 per cent. to $34,678,054; cement, 15 per cent. to $11,922,228; aerated waters, 20 per cent. to $10,481,558; brick and tile, 11 per cent. to $10,005,409; stone dressing, 30 per cent. to $7,265,822; lime, 14 per cent. to $4,472,780; cement products, 57 per cent. to $4,175,973; products from imported clay, 18 per cent. to $2,462,934; asbestos and allied products, 23 per cent. to $2,050,432; clay sewer pipe, 25 per cent. to $1,420,993; sand-lime brick, 13 per cent. to $1,060,148; fire brick and similar products from domestic clay, 24 per cent. to $887,666; stoneware and pottery, 16 per cent. to $359,562. Production from the glass industry declined 4 per cent. to $18,571,196 and the salt industry dropped 7 per cent. to $1,495,971.

Imports into Canada of non-metallic minerals and their products totalled $162,172,427 in value during 1928 as compared with $155,404,666 in the previous year. Imports of coal and its products were valued at $61,245,395 and imports of petroleum, asphalt and their products, chiefly crudes, were worth $62,640,866. United States supplied $129,617,884 worth, or 80 per cent. of Canada's imports in this class, while only $11,889,385, or 7 per cent. came from the United Kingdom. Exports from Canada during 1928 were valued at $26,588,611 as against $26,932,012 in 1927. Exports of asbestos and its products were worth $11,046,182; exports of coal and its products were valued at $5,606,796, and stone and its products exported, were valued at $6,365,998. United States took 65 per cent. of Canada's exports of non-metallic minerals and their products and the United Kingdom took about 6 per cent.

THE COAL TAR PRODUCTS INDUSTRY IN CANADA.

The Dominion Bureau of Statistics at Ottawa, in a report just forwarded to the High Commissioner of Canada in London, states that the output from the coal tar products industry in Canada in 1928 reached a new high level of $4,405,907, which is 16 per cent. in excess of the total for 1927.

Most of the increased production was in respect of pitch and road tars, which are extensively used in the building of the newer types of highways. Statistics for this group cover the operations of 19 plants, of which 10 were engaged in the distillation of coal tar and 9 manufactured disinfectants.

PHOSPHATE IN CANADA, 1928.

According to information received from the Mines Branch of the Dominion Department of Mines at Ottawa, the production of phosphate in Canada during 1928 was 486 tons valued at $5,611, as compared with 151 tons valued at $1,717 in 1927.

Phosphate rock valued at $44 was exported during the year, while imports, which are derived principally from the United States, totalled 10,181 tons valued at $67,842, as compared with 17,485 tons valued at $94,758 in 1927.

Previous to 1927 ,practically all of the small production of phosphate in Canada for the last ten or fifteen years consisted of apatite recovered from old waste dumps or secured during mining operations for mica in the Ontario-Quebec mica-phosphate field. Most of the output was taken by the Electric Reduction Company, at Buckingham, Quebec, and is presumed to have gone into $10,621,018 in 1927.

Exports of asbestos (incuding sand and waste) in 1928 amounted to 264,921 tons, consisting of 8,850 tons to Great Britain; 207,182 tons to the United States; 17,049 tons to Germany; and smaller tonnages to Australia, Belgium, Denmark, France, Italy, Japan, Mexico, the Netherlands, New Zealand and Spain.

Capital employed in the asbestos mining industry in Canada by the 7 operating firms was reported at $35,705,212. Employees engaged in this industry numbered 3,170 including 147 on salary and 3,023 on wages; their total earnings amounted to $3,989,644. Fuel and electricity cost $1,177,715, including $687,892 for 62,598,252 kilowatt hours of electricity.

Ten plants in Canada manufactured asbestos products including asbestos paper and mill board ;asbestos roofing of all kinds; asbestos rigid shingles; asbestos building materials; asbestos cellular, and sponge-felted pipe insulation; insulating sheets and blocks; asbestos brake linings and clutch facings (woven on special looms); and asbestos packings for steam, oil and hydraulic operations. In 192 8production from these plants was valued at $2,050,432.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

MEETING IN DUSSELDORF, SEPTEMBER, 9-12.

The arrangements for the Düsseldorf Meeting of the Institute of Metals are now complete and the meeting promises to be a notable one in every way. Over 200 persons from ten different countries will take part in the gathering. The proceedings will open on September 9 with the Annual Autumn Lecture. This will be given by Dr. A. G. C. Gwyer on "Aluminium and its Alloys." Visitors' tickets admitting to the Düsseldorf meeting may be obtained on application to the Secretary of the Institute of Metals, 36, Victoria Street, London, S.W.1.

Dr. A. G. C. Gwyer, of Warrington, England, who will deliver the Eighth Autumn Lecture to the Institute of Metals at Düsseldorf, on September 9 ,1929, is a and an Original Member of the Institute. He Member of Council of the Institute of Metals was born in Bristol, and studied at University College (now the University of Bristol), taking the degree of B.Sc. as an external student of London University. He held the Capper Pass metallurgical scholarship for two years, and subsequently was awarded a research scholarship by the Royal Commissioners of the Exhibition of 1851. With the aid of this research scholarship he spent two years at the University of Göttingen, carrying out metallographical research under Professor Tammann. Dr. Gwyer took the degree of Ph.D. at Göttingen. The title of his Inaugural-Dissertation was "Uber Die Legierungen des Aluminiums mit Kupfer, Eisen, Nickel, Kobalt, Blei und Cadmium." Upon returning to England he spent one complete session carrying out scientific research in Sir William Ramsay's Laboratory at the University of London, but subsequently decided to adopt a metallurgical career and took the metallurgical course at the University of Birmingham. In 1911 Dr. Gwyer was appointed unior Assistant in the Department of Metallurgy at the National Physical Laboratory, Teddington, and in 1912 he became Research Metallurgist to the British Aluminium Co., Ltd., Milton, Staffordshire. He was transferred in 1915 to the Warrington Works of the same Company, and in 1920 appointed Chief Metallurgist. Dr. Gwyer is part-author of several papers dealing with the constitution of aluminium alloys, that have been published in the *Journal* of the Institute of Metals.

DEPARTMENT OF OVERSEAS TRADE.

APPOINTMENT OF AGENTS, ETC., IN DOMINICAN REPUBLIC.

Mr. W. H. Gallienne, H.M. Consul and Charge d'Affairs at Santo Domingo, has furnished the Department with a memorandum on the appointment of agents, terms of credit ,shipping facilities, etc., in the Dominican Republic.

United Kingdom firms interested in this market may obtain copies of the memorandum on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (quoting reference No. 9905/27). The Department will be pleased to assist British firms desirous of appointing agents in that market.

NOTICES OF BOOKS.

Everyday Chemistry. By PROFESSOR J. R. PARTINGTON, M.B.E., D.Sc., Prof. of Chemistry at East London College, University of London, and late Fellow of Manchester University. Pp. 668. Price 7s. 6d. London : Macmillan & Co., Ltd., St. Martin's St., W.C.2.

This is a well prepared book intended for students preparing for matriculation and other examnations. It consists of three parts, historical and theory, non-metals, organic chemistry and metals. While helpful to the student, the book will also prove interesting to numbers of educated persons, who desire to widen their sphere of useful information.

Chemistry in the Home. By J. B. FIRTH, D.Sc. (Manch.), M.Sc. (Dunedin), F.I.C., Senior Lecturer in Chemistry, University College, Nottingham. Pp. 246. Price 5s. net. London : Constable & Co., Ltd., Orange Street, London, W.C.2.

The ever widening application of chemistry to most matters connected with everyday life renders this work useful alike to student and ordinary intelligent reader. Divided into two parts, we note that Part I deals with divers topics with which people are brought in daily contact, while Part II largely deals with dietary and the nature, composition, and preparation of foods.

Industrial Chemistry.

The Science Museum, South Kensington, London, S.W.7., has issued a useful handbook describing the collection illustrating

Industrial Chemistry in the Museum. The book is really much more than a mere catalogue, as will be obvious on a casual glance to any reader. In a word, the information is varied, interesting, and given in a succinct form, while the alphabetical index is of a detailed nature, enabling the reader to refer promptly to any desired piece of information.

Pitman's Technical Dictionary of Engineering and Industrial Science, in seven languages, is now complete, and the Fourth Volume was published on August 12. Edited by Mr. Ernest Slater, M.I.E.E., M.I.Mech.E., the *Dictionary* is the work of many experts and contains a most complete list of technical words, terms, and phrases with their equivalents in French, Spanish, Italian, Portuguese and Russian.

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BOARD OF TRADE ANNOUNCEMENT.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

The total number of applications received during July was 671, of which 581 were from merchants or importers. To these should be added 20 cases outstanding on the 29th June, making a total for the month of 691. Of the total of 691 applications received, 629 or 91 per cent. were dealt with within 7 days of receipt.

Board of Trade, 6th August, 1929.

TENDERS FOR SOUTH AFRICA.

His Majesty's Senior Trade Commissioner in South Africa (Mr. N. Elmslie) reports that the South African Railways and Harbours Administration are calling for tenders, to be presented in Johannesburg not later than 1 p.m. on Thursday, 19th September, 1929, for the supply and delivery of 290,500 lbs. of carbide of calcium.

British firms desirous of offering carbide of calcium can obtain further particulars of this call from the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference B.X. 5586 should be quoted.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

28,795.—American Potash and Chemical Corporation. — Borax product. August 2.

28,424.—Arnold, C. (Harshaw Chemical Co.).—Effecting chemical reactions. July 30.

28,648.—Bataafsche Petroleum Maatschappij.—Manufacture of ethers. August 1.

28,350.—Gibbs, W. E. — Treatment of waste gases containing oxides, etc. July 30.

28,274.—I. G. Farbenindustrie Akt.-Ges. and Johnson, A. E.—Manufacture of vat dyestuffs. July 29.

Specifications Published.

316,231.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of chromiferous dyestuffs.

816,156.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture and production of vat dyestuffs.

816,198.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges). — Manufacture and production of complex chromium compounds of azo dyestuffs.

804,744.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo-dyestuffs.

289,097.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 1-amino-anthraquinone-2-sulphonic acid.

Abstract Published.

813,562.—Dyes.—Chemische Fabrik vorm Sandoz, Basle, Switzerland.

Azo dyes are made by coupling a tetrazotized diaryldiamine (1 mol.) with H acid (1 mol.) in acid solution combining the intermediate product wth a monodiazo compound (1 mol.) and a N-alkyl-, aryl- or aralkyl-*m*-aminophenol or derivative thereof (1 mol.) in alkaline solution. They dye mixed wool and viscose goods in level and equal black shades. In an example, the diazo compound of the product aniline —> H acid <— benzidine is coupled with N-(*o*-tolyl)-*m*-aminophenol. The aniline may be replaced by the *toluidines, chloranilines, &c., the benzidine* by toluidine, &c., and the end component by N-monoethyl-, N-diethyl-, and N-(*p*-tolyl)-*m*-aminophenol. Specification 12805/02 is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DEXTRAMITE.

501,184.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—The Chemical and Insulating Company, Limited, West Auckland Road, Darlington, County Durham. August 7.

500,998.—Interwoven black and white triangles and the letters B.M.C.P.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes. — B. M. Chemical Products, Limited, 49, Eastcheap, London, E.C.3. August 7.

PROJUTIN.

501,046.—All goods in class 1 which includes chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. — Paul Gulden, 54, Karl Heinestrasse, Leipzig W.33, Germany. August 7.

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NOTES ON ATOMIC ENERGY AND RADIATION.

By F. H. Loring.

This is a statement of some ideas developed in connection with atomic energy and radiation. The views here advanced only partly agree with the latest phases of the subject, there being some features that *radically* depart from those which are now current.

1.—When we some to very small things—in a certain discriminating heat-sense—we come to random arrangements, or a random activity, of the parts; as, for example, in the case of an incandescent body. Then the second law of thermodynamics is applicable; and it is here that the quantum theory points the way to a modified view as sketched below. The randomness here referred to may be considered in terms of entropy that tends to increase in the sense that the shuffling of a pack of playing cards increases the randomness of the cards and this cannot be undone, or put back, by further shuffling, as the second law of thermodynamics indicates. Entropy, taken as the *transformation* of motion into heat, indicates a state of rundownness, to make use of a known expression.* Heat and light inherently spread and of their own accord do not converge.

2.—The spectrum of an incandescent body or of a flame tells us that a random action is taking place and the eqnation that specifies the emission lines is a probability or random type of formula; at any rate, according to these views it should be so.

3.—Consider radiation passing out as orderly sheet-like disturbances following one another in a regular concentric fashion. This may be, and probably is, a much too articial concept, but it serves to illustrate the point. When such an ordered sequence of waves meets matter it falls on a heterogeneous collection of atoms which do not take it up, or swallow it, as a whole; but it gets absorbed here and there according as certain atoms happen to be favourably placed.

* In general, $d\phi = dQ/T$, when ϕ is the entropy, T is the temperature on the thermodynamic scale (absolute temp. scale) and dQ is the quantity of energy introduced into the system (*not* produced within it), " this is the simplest expression for the Second Law of Thermodynamics." — See Jeans' Dynamical Theory of Gases (1916), p. 78.

4.—The converse is true in so far that when these atoms are excited they emit radiation in precisely the same simultaneous random way—here one and there one sets up the disturbance in the æther.

5.—If these atoms are excited to a very high frequency, proportionately fewer respond, because the whole business of high excitation renders it improbable that relatively great numbers of atoms can be so excited owing to the randomness of the atoms, etc. The radiation itself may have in one sense a random characteristic.

6.—The converse is true in that only here and there an atom can absorb the high-frequency radiation. Planck's famous equation gives, or should give, expression to this idea. It is the nature of things that this should be so.

7.—When a great many random events are sorted out and graded, as the prism does in respect of the spectrum, a certain characteristic order appears.

8.—Now it seems to me that the favoured atoms, being those which are so situated as to absorb radiation, would absorb it greedily, so that they really receive more than would be expected judging by their sparsely distributed, or the surrounding random, state of affairs. A hungry and exhausted man recovers his energy with a comparatively small amount of rest and food. This means that a surplus factor enters into the transaction, and it may be this surplus factor that leads to the stationary states in the Bohr atom which are so remarkable and so contrary to classical mechanics.

9.—In gases there must be some molecules that have received blows in the same direction without being checked in their momentary movement. Hence they possess energy greater than that of the average of the other molecules. Such molecules would have for a very short time a surplus of energy.

10.—Surplus of position, so to speak, and surplus of kinetic energy, whether these be considered positive or negative, come to the same thing in the main sense here intended. That is to say, a position may be such as either to give or to take relatively great energy when correspondingly the release or absorption takes place. It is then the *occasional atom* in the random arrangement that has this favoured state whereby it either gives out or takes in more energy than would otherwise be the case; and in the event of the photoelectric effect, the atom gives out more energy than its normal state

would seem to permit, *i.e.*, it ejects an electron with considerable velocity, representing more energy than that afforded, or measured, by the area of the radiation that falls upon the atom.

11.—The photoelectric sensitivity of molybdenum shows a decrease with rise of temperature from 0° C. to 1000° C.—See M. I. Martin (*Phys Rev.*, June, 1929, *33*, 901). This fits in with the opening statement above (1) and with those that follow, but there ıre other cases which are not so good in this espect. They no doubt involve obscure onditions to be taken into account.

12.—It seems to me that the internal heat of stars arises from this randomness being ıs it were undone or initially prevented, so hat greater energy appears than can be acounted for by ordinary average laws of nergy as experienced on the earth. Perhaps lso the energy of gravitational consolidaion has been made potential in some way nd this is now becoming active and unctions as a contributory cause. As a ırther step, Einstein's well-known energy quation, involving the conversion of ıatter into radiation, might be considered ı this connection, though from the point of iew of this argument if extended it becomes nnecessary. It may be translateable into different conception, but as yet this is oubtful.

13.—If, as seems possible in the sun and ars, the parts which are disposed at ranom as stated above (1), are held or forced to ordered arrangement by great pressure volving gravitational consolidation, even ough incandescent, then the initial excitaon of such parts may not sufficiently disrb their ordered arrangement as to have troduced the random state. Consequently e energy is initially emitted as radiation a much more profuse manner. Perhaps ain the annihilation of matter and the rresponding production of radiation* ould be considered here; though, as above ıted, the argument seems possible of delopment without this idea, or with an ıendment in its statement.

14.—It is true that probability law as sed upon statistics is a confession of orance as to the detailed working of iirs, but the gain in knowledge effected reby, should help to clear away the per mystery. The reader may be ected to Allen's THE QUANTUM THEORY ı ITS INTERPRETATION (1928), pp. 21, 240, 241, 242, for some views touching on *probability* in these matters. See also an article by the present writer entitled: The Absolute Zero of Temperature; Specific Heats of Gases; and Deductions respecting Quanta:—*Chemical News*, 1929, *138*, 18, 81. Jeans' little book, ATOMICITY AND QUANTA (1926), is still of interest as showing not only alternative views, but the difficulties encountered in the problem under discussion here. Of value in this connection is Max Planck's book A SURVEY OF PHYSICS (1925).

The following quotation (p. 178) from this book summarises one phase of the problem involved in the above discussion. "A question, from the complete answer to which we may expect far-reaching explanations, is what becomes of the energy of a light quantum after perfect emission? Does it spread out, as it progresses, in all directions, as in Huygens' wave-theory, and while covering an ever-larger amount of space, diminish without limit? Or does it travel along as in Newton's emanation theory like a projectile in one direction? In the first case the quantum could never concentrate its energy in a particular spot to enable it to libtrate an electron from the atomic influences; in the second case we would have the complete triumph of Maxwell's theory, and the continuity between static and dynamic fields must be sacrificed, and with it the present complete explanation of interference phenomena, which have been investigated in all details. Both these alternatives would have very unpleasant consequences for the modern physicist." It is one of the objects of science to avoid arriving at this serious dilemma. Just as gravity has such a far-reaching influence, so, too, the energy of the spread-out radiation has a similar influence which acts in a concentrating way; but how, we do not know. The views advanced, while not antagonistic to such an action, demand favourable states and some *quid pro quo* at the atomic end of the transaction. See in this connection pages 179 to 199 in Eddington's book, THE NATURE OF THE PHYSICAL WORLD (1928) (reviewed in *The Chemical News*, Jan. 18, 1929, *138*, 33). I will quote in part the gist of what Prof. Eddington says:— Enthusiasts discussing theoretical physics soon arrive at their "desperate state of ignorance." This is not modesty, but that Nature has "hidden her fundamental secret successfully from such powerful intellects as ours. . . We have turned a corner in the path of progress and our ignorance stands revealed before us, appalling and insistent. There is something

* The dissolving of matter (matter as ordinarily understood) into radiation.

radically wrong with the present fundamental conceptions of physics and we do not see how to set it right.

"The cause of all this trouble is a little thing called h which crops up continually in a wide range of experiments. In one sense we know just what h is, because there are a variety of ways of measuring it . . ." $h = 6.55 \times 10^{-27}$ erg $\times$ seconds. Something very small obviously, but the important feature is the erg $\times$ seconds, that is to say, energy multiplied by time. We often *divide* energy by time, as when the energy output of an engine is divided by time, giving the H.P. "Conversely an electric supply company multiplies the horse-power or kilowatts by the number of hours of consumption and sends in its bill accordingly; but to multiply by hours again would seem a very odd sort of thing to do. But it does not seem quite so strange when we look at it in the absolute four-dimensional world. Quantities such as energy, which we think of as existing at an instant, belong to three-dimensional space, and they need to be multiplied by a duration to give them thickness before they can be put into the four-dimensional world." For example, take humanity, occupying a given space, at 40 million men. "Consider this as a portion of space-time, say, Great Britain between 1915 and 1925; we must describe the amount of humanity in it as 400 million *man-years*." The analogy is perhaps clear, and this result is called *action*. "Erg-seconds or action belongs to Minkowski's world which is common to all observers, and so it is absolute. It is one of the very few absolute quantities noticed in pre-relativity physics. Except for action and entropy (which belongs to an entirely different class of physical conceptions) all the quantities prominent in pre-relativity physics refer to the three-dimensional sections which are different for different observers." Before relativity showed that *action* was of "importance in the scheme of Nature on account of its absoluteness," some investigators of theoretical dynamics were fairly reeking with it. For example, Sir William Hamilton and later Prof. E. T. Whittaker. To the unskilled in these matters it seemed "to make easy things difficult," but in the end it (action) was justified. As Einstein found ready made the tensor calculus, which he needed for developing his theory of gravitation, so, too, "the quantum physicists found ready for them an extensive action-theory of dynamics without which they could not have made headway." But this did not prepare "us for the discovery that a particular lump of it can have a special importance," and yet h, this particular lump, "is continually turning up experimentally." Atomic action will not do. It will not work. Physics cannot in its present form tolerate it, but the problem is to discover the particular change required.

I will not abstract further except to quote a few disconnected passages hoping that the reader will consult the original. Speaking of the photoelectric effect, which is the crucial phenomenon, Eddington says :—"Attempts to account for this phenomenon follow two main devices which we may describe as the 'collection-box' theory and the 'sweepstake' theory, respectively. Making no effort to translate them into scientific language, they amount to this : In the first the atom holds a collection-box into which each arriving group of waves pays a very small contribution; when the amount in the box reaches a whole quantum, *it enters the atom*. In the second the atom uses the small fraction of quantum offered it to buy a ticket in a sweepstake in which the prizes are whole quanta; some of the atoms will win the whole quanta which they can absorb, and it is these winning atoms in our retina which tell us of the existence of Sirius. The collection-box explanation is not tenable. As Jeans once said, not only does the quantum theory forbid us to kill *two birds with one stone; it will not even let* us kill one bird with two stones." See his little book cited above where this illustration occurs.

"*The light calls the tune, therefore the light must pay the piper.* Only classical theory does not provide light with a pocket to pay from."

"The unexpected phenomenon is that instead of each atom absorbing one-millionth of a quantum, one atom out of every million absorbs a whole quantum."

"In addition to the propagation of uniform waves the propagation of a photon or 'ray of luck' is involved."

"Small contributions of energy are not thankfully received, and electrons which offer anything less than the full contribution for a jump are not allowed to make any payment at all."

"For an example I will borrow a quantum conception from the next chapter. It may not be destined to survive in the present rapid evolution of ideas, but at any rate it will illustrate my point. In Bohr's semi-classical model of the hydrogen atom

there is an electron describing a circular or elliptic orbit. This is only a model; the real atom contains nothing of the sort. The real atom contains something which it has not entered into the mind of man to conceive, which has, however, been described symbolically by Schrödinger. This ' something ' is spread out in a manner by no means comparable to an electron describing an orbit. Now excite the atom into successively higher and higher quantum states. In the Bohr model the electron leaps into higher and higher orbits. In the real atom Schrödinger's ' something ' begins to draw itself more and more together until it begins sketchilly to outline the Bohr orbit and even imitates a condensation running round. Go on to still higher quantum numbers, and Schrödinger's symbol now represents a compact body moving round in the same orbit and the same period as the electron in Bohr's model, and moreover radiating according to the classical laws of an electron. And so when the quantum number reaches infinity, and the atom bursts, a genuine classical electron flies out. The electron, as it leaves the atom, crystallises out of Schrödinger's mist like a genie emerging from his bottle."

It will be seen that from these ideas h seems to function almost as a contracting or concentrating constant, as distinguished from c, which is a spreading constant, so that, like gravity, *the spread-out radiation can act concentratedly on the occasional or chance atom*, as in the photoelectric effect. When the æther is brought into the picture it perhaps functions in some elastic way. When a piece of glass is scratched it is easy to break it by the application of a small force. In electrical phenomena there are the *inside* and the *outside* phases (see *Chemical News*, 1929, *138*, 360) so that one might say that the converse of c is h, and when R_∞ is introduced and a numerical constant 24, one can be deduced from the other, since $c = R_\infty / (24 \times 10^{-33} / h)$, as I have shown several times in these columns.

In this complex of affairs no mention has been made of *radioactivity*. Is not this also in some way energy multiplied by time? This being an *inside* phenomenon time has to be taken reciprocally, for the shorter the life of the radio-atom the greater the energy given out as *mass radiation*.

Jeans' Report on Radiation and the Quantum Theory (1924) is still of interest. See for example Chapter VIII.

Some articles of mine on the photoelectric effect (*Chemical News*, 1927, *134*, 129; *135*, 296) bear on the subject here discussed.

There is one feature to be kept in mind, namely, that the randomness or its counterpart has no fixed value, but is relative to the nature of the radiation in the case of absorption and presumably of emission also.

In conclusion, may I be permitted to remark that Nature is so big and generous that we can get at some of her secrets by widely different methods. I do not believe, however, that the newer views here advanced represent as yet the *different method*, but they may be suggestive. As I have had occasion to remark before, I must again say that the assurance with which some of the above statements are made is not intended as a guarantee of their accuracy.

MATTER AND LOGIC.

By Dr. W. Tombrock.

The Connection between Proton and Cosmic Rays.

Protons are the units of which the atom is constituted, the bricks with which it is built.

We considered protons to be larger strongly rotating material particles, large compared with the ether-particles which swarm between and around them. Protons in so doing would form a cyclonically stable configuration of motion which we call an atom and which is as a whirlpool in the ether itself The stability is made possible by the ether-particles. . . a proton complex merely consisting of several protons would necessarily explode on the least contact. We considered it to be possible to explain the disintegration of the radium atom by a diminished ether-pressure. . .

There is now the possibility that the proton is not actually a material unit but really in turn forms a cyclonically stable configuration of ether-particles; thus may be in itself nothing more than a cyclone or whirlpool in the ether. As far as its stability is concerned the external character of the proton then still remains the same to us, the proton remains a unit, though a complex one which, although being of variable composition, by its rotary behaviour with regard to its surroundings may yet be considered a material unit . . . but now in the case of a sudden rarifaction of the ether occurring we obtain something different. Not only might

the atom then fly to pieces but also . . . the proton itself. And this, if anything, must be able to explain the production of cosmic rays (Millikan rays), when then yet more stably constituted matter was reformed in a more rarified ether.

It is a question whether this condition can be realised experimentally. I believe that experiments in this direction have already been taken in hand in Sir E. Rutherford's laboratory.

August, 1929.

Bergen op Zoom.
Holland.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION I.—PHYSIOLOGY.

PHYSIOLOGY THE BASIS OF TREATMENT.

Address on July 24, by PROF. W. E. DIXON, M.A., M.D., F.R.S., President of the Section.

The ultimate aim of medicine is the prevention or cure of disease : this practical aspect so far dominates all others that it is often referred to as the healing art; indeed, it is difficult to think of medicine apart from treatment.

The term ' Physiology ' is usually used to designate the science of function, whether it is studied in broad outline and dealing with the mechanism of action or as the physico-chemical mechanisms leading up to this action. Disease means the unusual functioning of tissues which may be the result of accident, hereditary weakness, or parasitic organisms. Generally it is wrong to speak of this as malfunctioning : the unusual functioning is physiological and perhaps the best for the organism under the unusual conditions. The science of medicine then is nothing more than trained and organised common sense based on physiology. It is still usual to speak of it as an exact science; this is obviously wrong since medicine uses the same methods as every other science and the results of observation are as definite as those o fthe chemist or physicist, although it is true that in the complexity of the problem with which the physician may have to deal all the conditions of importance may not be known and the results of an investigation though correct for the conditions under which it is undertaken may be misleading.

But it is not with medicine as a whole that I wish to direct your attention to-day, but only with that part of physiology which forms the basis of treatment.

When the sciences of physiology and pathology a century ago passed from the realms of natural history to deduction and experiment, they naturally attracted the more original and eager minds in medicines, and the text of the writings of the nineteenth century deals with changes in structure and function. Treatment became neglected, the old shibboleths and rituals of treatment which had held sway for centuries were discarded, and there was nothing with which to replace them. In the middle of the last century S. Skoda and K. Rokitansky (in Austria) perfected a system of physical diagnosis which has had a practical bearing on medicine ever since. Skoda made many experiments with drugs on the patient without any evpectation of producing benefit; the patients were not improved and Skoda thought it mattered little how the patient was treated. It is right to say, however, that these experiments were deficient in many respects according to modern views. At this period the Vienna School held a prominent position in scientific medicine and the new doctrine rapidly spread. The physician studied disease in the patient; its beginnings, its progress, its effects, and the scars it left, as shown at autopsy. Scientific medicine looked askance at treatment; text-books spent many pages in describing the symptoms, diagnosis, and pathology of that in this meeting some reference should be made to that area of tropical Africa occupying more than a million square miles in which one form of these, namely, trypanosomes, produce their ravages.

Disease of man produced by trypanosomes is confined to tropical Africa and some of the adjacent islands. But an enormous belt of country stretching from Rhodesia northward to the Bahr el Ghazal, and from the Cameroons westward to Tanganyika is inhabited to a greater or less degree by the infected tsetse fly. Two forms of trypanosomes are known to infect man, *T. Gambiense*, which is especially common in the neighbourhood of the two great lakes, Victoria and Tanganyika, and northward of these to the tributaries of the Nile. The other, *T. Rhodesiense*, is mainly found in the country surrounding Lake Nyasa, Portugese East Africa, Nyasaland, and Rhodesia : this form is more rapidly fatal than *T. Gambiense*, and its treatment is less satisfactory. Epidemics may occur in different

districts from time to time: thus in 1900 an epidemic occurred in the Belgian Congo in the neighbourhood of Kisantu, in which two-thirds of the population succumbed within ten years. It is probable that the population on the northern border of Lake Victoria Nyanza had existed for generations without trypanosomes (sleeping sickness), although Glossina, the carrier, was plentiful. It then happened that some migration of natives, possibly caravan porters from the Congo, introduced the trypanosome, and a terrible epidemic of *T. Rhodesiense* swept the country in 1898, spread round the Lake and killed about 300,000 natives. The natives and their cattle were removed in 1909 and the infested district was left to the fly. Dr. Duke points out that the *Glossina Palpalis* had hardly diminished in the succeeding eight years and he regards wild game as a trypanosome reservoir; he showed in 1911 that the situtunga serves as a mammalian host for the trypanosome as well as man, in the same way as N'gana is carried by many species of game; in this way the fly retains the trypanosome which causes sleeping sickness. In Uganda, at any rate, lizards and crocodiles form the chief sources of food for *G. Palpalis*.

T. Gambiense is transferred by *Glossina Palpalis*, *T. Brucei* by *G. Morsitans* and *Pallidipes*, and *T. Rhodesiense* by *G. Morsitans*. Innumerable other instances might be given of its ravishes in the whole of the Congo, Cameroons, and other parts of Africa. Besides the human form of the disease another tsetse fly is responsible for the trypanosomes of domestic animals, including horses and cattle, *T. Brucei*, which produces the disease N'gana, so that in infected districts draft animals and dairy cattle cannot exist.

Trypanosomiasis is one of the most serious of all tropical diseases and affects both man and beast; it is a scourge which renders vast tracts of land practically uninhabitable and which takes its death toll often in thousands and occasionally even in hundreds of thousands, and yet it is a disease which I believe should be curable if not preventable. The problem is one of wide interest and importance — scientific humanitarian, and economic. The members of two groups of chemica lsubstances excel all others in their curative value in trypanosomiasis and spirochaetosis; these are the organic arsenical compounds and the dyes.

(*To be continued.*)

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

(*Concluded from page* 120.)

I now come to another of our new ventures, namely the monthly Summary of Information on Chemical Trade. The underlying intention was to bring together in a readily accessible and convenient form the information which is published in a variety of journals on subjects bearing on chemical trade, such as import and export statistics, tariffs, production data, new companies, amalgamations, etc. A short summary of this nature has been presented to Council every month for some years, and the General Manager suggested that if it was of value to Council it might be equally useful to members generally. The replies to the General Manager's enquiry regarding such a summary were so encouraging that we decided to proceed with the idea. Since the original conception, the scope has been much extended and improvements in the arrangements have been effected. It is now a regular feature of our work and its issue in printed form makes it a far more presentable and readable document. It appears to be serving a useful purpose as the demand for it has been steadily increasing with the result that about 180 copies are now issued regularly. We are anxious to make it as useful as we can to our members and would therefore welcome any suggestions regarding subject matter or presentation which would tend in this direction. In this connection I would like to draw attention to the fact that the Association is in a position to obtain for members, lists of importers for various countries in the world and to make confidential enquiries regarding the status of foreign firms, traders or dealers with whom members may desire to open negotiations.

The Traffic Committee had continued to perform its very valuable work on what is a very complicated subject, and as you will see from the Report, has been able to obtain from the Railway Companies various concessions and improvements in regard to rates and regulations which will be of considerable financial benefit to members.

The last item on the Report deals with the various bodies on which the Association is represented and with which it has active dealings. I might add that we have in the past year established relations with the corresponding organisations in America, Belgium, France, Germany, Italy, Sweden and Switzerland, and have obtained useful details of their constitution and activities.

As regards the work ahead of us, we shall continue to keep a close watch on all new legislation to see that due consideration is given to the interests of our industry. We have also certain important activities to carry to a concusion such as our deliberations in regard to Patent Law Reform and the compilation of Part II of our Model Safety Rules. We shall ,of course, continue our monthly Summary and our Safety Circulars as regular features, and shall deal with any other questions affecting the industry which may arise. Though we have a big programme of useful work ahead of us, we are anxious to extend our sphere of usefulness, and I would therefore invite you all to submit any suggestions which may occur to you as to new lines of activity which we might undertake on your behalf.

In conclusion, I wish to express my appreciation of the work of the staff and to thank them for their loyal services. The work during the past year has been of a particularly onerous nature. Our own Directory has been completely revised and issued, a very heavy task indeed, as has also been that of the Plant Associsation. Part I. of the Model Safety Rules has been completed and some 14 Safety Circulars have been prepared; the monthly Summary on Chemical Trade has been successfully started as have been similar summaries of technical and general information for two of our affiliated Associations, namely the British Chemical Plant Manufacturers Association and the Association of British Insecticide Manufacturers. These special activities coupled with the normal routine work which has been steadily increasing, have thrown a heavy burden on all members of the staff; without their willingness and energy it would not have been possible for us to have done what we have. (Loud applause.)

Mr. C. A. Hill, in seconding the Report, referred to the necessity of keeping the Board of Trade fully informed of the activities of the industry in all its branches. In particular he mentioned the possibility of new legislation in connection with the Safeguarding of Industries Act and expressed the opinion that the Fine Chemical makers should view the situation with extreme alertness, but that their alertness should be tempered all the while with confidence that no Government, whatever its political views, whether Free Trade or otherwise, could do anything which would mean the scrapping of the work that had been done and jeopardise the capital which has been sunk under an Act of Parliament which had been given for ten years. He asked the Fine Chemical makers to take that view, but, nevertheless, to bear in mind the very pregnant remarks which the Chairman had made on the necessity of preparing really reliable and full statistics which could enable the Association to present a convincing case at the moment when it was called upon to do so.

After the Honorary Treasurer (Dr. E. F. Armstrong, F.R.S.) had made a statement regarding the accounts, a general discussion followed.

The Rt. Hon. J. W. Wilson, in commenting appreciatively on the Chairman's Address, referred to the fact that there was still a number of firms engaged in the chemical and closely allied trades which were not members of the Association, and stressed the importance of securing them as members of the Association or of its affiliated bodies, in order that the Association might be representative of the whole of the industry. He congratulated the General Manager upon the popularity and the increasing interest and completeness which he had put into the Monthly Summary on Chemical trade. He stressed the importance in this busy world, and especially in business, of having such a Summary, as manufacturers did not have time to hunt up various sources of information themselves. He suggested that a more detailed index might be wanted if the report increased in volume.

With regard to Exhibitions, he was glad that the Department of Overseas Trade had decided to carry on in a new building and new surroundings. He hoped that the educational side of the Exhibitions would be still further extended. He dealt with the pros and cons of exhibitions and the importance of not giving away information which foreign competitors might utilise, and commented on the lack of chemical exhibits in most of the continental fairs and exhibitions. He concluded by expressing the view that the educational and publicity side of the Exhibition justified the firms who had taken so much trouble to show creditable exhibits, and that the balance of argument was in favour of continuing.

Mr. R. G. Perry referred to the importance of statistics, and urged the Chemical Industry to give all the information they could in connection with the 1931 Census of Production. At present the Chemical Industry ranks third as regards the amount of information supplied, but as there was plenty of room at the top, he strongly recommended that they should endeavour to become first.

Mr. C. S. Dingley supported Mr. Wilson's views regarding the value of the Monthly Summary.

Dr. E. F. Armstrong suggested that the Council might profitably turn its attention in two directions. He thought that the new Government would be far more receptive to science and its applications than, perhaps, some previous Governments had been, and that we might well make representations so that the Associations, or its members, might in some way form an Advisory Panel to the Departments of the Government. On the second point, experience during the past year had led him to believe that there was a good deal more room for collective research by the Association; there were certain sections where collective research on big problems of common interest. He thought there was an opportunity in respect of certain sections of Chemical Industry for such collective research; those sections were badly in need of it and it might help them to solve problems which were much too wide and too costly to be attacked by individual firms.

The Chairman then put the resolution to the meeting and declared the Repart and Accounts unanimously adopted.

Election of Auditors.—On the motion of Mr. K. H. Wilson, seconded by Mr. C. S. Dingley, Messrs. Feasey & Co., who have now changed their name to Messrs. Feasey, Hull and Hornsby, were re-elected auditors.

The reception of the General Manager's Report on the nominations for Council and for Group Committees and a vote of thanks to the Chairman, which was proposed in a delightful speech by Mr. R. M. Bewick, concluded the business of the meeting.

VITAMIN B CONTENT OF THE POLISHED RICE KOJI.

By Ryohei Takata.

The "koji" is the product of cereals on which Aspergillus oryzae is grown, and is widely used in Japan as th esaccharifying agent in saké- soy- miso-making, etc.

As the present author has previously reported, the mycelium of Aspergillus oryzae is rich in growth promoting and anti-neuritic Vitamins, and therefore the koji which contains the mycelium of this fungi is supposed to contain these vitamins also.

The present author examined the koji prepared fro mpolished rice for the content in growth promoting and anti-neuritic vitamins, using young albino rats and young pigeons respectively.

The rats, fed with 76 per cent. of polished rice koji as the sole source of these vitamins, grew somewhat below normal, reaching 105-142 gr. in 3 months, but after then the growth stopped and began to decrease their body weights, while those receiving 76 per cent. of polished rice died within two months. Thus, the polished rice koji contains the small quantity of this vitamin.

The pigeons fed with 78 per cent. of polished rice koji, died in 30-41 days, showing the symptoms of polyneuritis, while those fed with polished rice died 28-35 day. Thus, the polished rice koji contains very small amount of this vitamin. Judging from the fact that polished rice, which was the raw material of koji, is devoid of vitamins B, there will be no object to conclude that Aspergillus oryzae can synthesise the Vitamins B in it.

GENERAL NOTES.

FODDER CROPS SITUATION.

In Europe, although the average monthly temperature was generally below normal and the falls of temperature at night which occurred especially in the latter half of June, rather hindered the development of the plants, yet on the whole Juné weather conditions favoured fodder crops except in a few countries (Belgium, the Netherlands, Great Britain and Italy) which experienced an inadequacy of rainfall.

To give the chief characteristics of the situation it may be stated that in Europe at the beginning of July the crop condition of clover, alfalfa, and temporary meadows was above average and in some countries also was good. Permanent meadows and pastures were in not quite so good condition, but ehrtheir crop condition also varied generally from average to above average. In comparison with last year, the situation is undoubtedly better in most of the areas of production.

In Canada and the United States the condition of fodder crops at the beginning of July was satisfactory although in some areas rainfall was needed.

Haymaking took place in most cases under favourable conditions; the quality of the hay is generally satisfactory and is less good only in countries which have complained of a lack of rainfall.

THE SITUATION OF MAIZE CROPS.

The greater resistance exhibited by maize prices to the general fall of cereal prices during past months has encouraged the cultivation of this crop; considerable areas sown under winter cereals were destroyed by the exceptionally severe winter frosts and had to be re-ploughed and sown with spring crops, technical agricultural reasons, which when the prolonged period of spring cold is considered, influenced the preference of maize for re-sowing the fields, these various circumstances combined have given rise to a new increase of the areas under maize in the principal exporting centres of Europe which, moreover, had already constantly increased their cultivation of this crop since 1921.

Grouping together the European countries for which figures for maize areas this year are available, into exporting countries on the one hand, and countries which are both producers and importers on the other hand, there is to be noted a clear indication of the continual increase of the total maize area in Bulgaria, Hungary, and Rumania, for example from 12,108,000 acres in 1921 to 15,815,000 acres in 1929, while in countries of the second group (France, Switzerland, and Czechoslovakia), the situation shows almost no change, the area remaining at about 5 million acres.

For the Kingdom of the Serbs, Croats and Slovenes, another important exporting country of Europe, the estimate of area sown under maize this year is still lacking, but it is known that it is considerably larger than for last year.

In the United States, the largest producer of maize in the world, but of limited importance in international trade in this product, the area cultivated with maize has decreased since 1921. Although the reductions compared with 1928 and with the average of the preceding five years are large in absolute figures: 2,400,000 acres and 2,700,000 acres respectively, the percentage decreases are only 2.4 per cent., and 2.7 per cent., and consequently the element which may principally influence the harvest results permanently, is the course of the season, more so than changes in area.

Preliminary information concerning the growth of maize in the northern hemisphere indicates that although the crops are a little backward compared with the normal, in general they have not been damaged by lack of moisture or by heat, and consequently have begun the critical period of their growth in good condition.

In addition to the official figures for production of maize during last season, those for Argentina are now available. A decrease in the production of this country had already been forecasted, but smaller than that indicated by the Government's forecast, and it had been taken into account in commerce.

CANADIAN CHEMICAL INDUSTRIES.

Canadian chemical plants producing acids, alkalies, salts and compressed gases all reported an output during 1928 valued at $42,836,846, a total of nearly $12,000,000 in excess of the corresponding figure for 1927. Statistics for this group in 1928 covered the operations of 41 establishments of which 16 made heavy chemicals and 25 manufactured industrial gases.

(a) *Acids, Alkalies and Salts.*—Production in the acids, alkalies and salts group in 1928 was valued at $39,190,962 of which $21,256,286 represented the value of sales and $17,934,676 the value of intermediates made and used in further processes by the producing plants. Sixteen plants were in operation including 9 in Ontario, 3 in Quebec, 3 in British Columbia, and 1 in Nova Scotia. Capital employed amounted to $40,024,624, employees numbered 2,517, salaries and wages totalled $3,490,409 and materials cost $22,925,404.

Excepting sulphuric acid, each of the commodities made in this industry was produced by onlq one or two plants. Sulphuric acid was made in 6 plants, nitric acid in 2, hydrochloric acid in 2, calcium carbide for sale in 2 and for intermediate use in 1, while each of the following commodities was made by only one concern: acetylene black, glacial acetic acid, hydrofluosilicic acid, phosphoric acid, butyl acetate, ethyl acetate, ammonium phosphate, calcium cyanamide, bleaching powder, soda ash, sodium, iron phosphide, paraldehyde, phosphorus, soda ash ,sodium cyanide, caustic soda, glauber's salt, salt cake and croton aldehyde. Production figures for these chemicals cannot be published separately.

(b) *Compressed Gases.*—Output value for the compressed gases industry totalled $3,145,884 in 1928. Capital employed was given at $4,226,037; employees numbered 426; salaries and wages amounted to $652,898; and materials cost $479,587.

Of the 25 plants in operation 11 were in Ontario, 6 in Quebec, 3 in Manitoba, 2 in Nova Scotia, 2 in British Columbia, and 1 in Alberta. Acetylene was made in 11 different plants; carbon dioxide in 7; oxygen in 12, hydrogen in 3, and aqua and anhydrous ammonia in 1 plant.

MASS NUMBERS OF THE CHEMICAL ELEMENTS AND OBSERVATIONS ON ELEMENT FORMATION.—A FURTHER SUPPLEMENTARY NOTE.

By F. H. Loring.

Further to my note in this Journal (Aug. 16, 1929, *139*, 108), it is of interest to record that R. T. Birge (*Nature*, Aug. 3, 1929, *124*, 182) says that "The calculated isotope lines based on either C12—N15, or C12—N16, lie far outside the limits of error. There are definitely no other isotope lines observable in this region of the band, so that one may conclude that if isotopes of nitrogen exist, they are much less abundant compared to N14, than C13 compared to C12." W. F. Giauque (*Nature*, Aug. 17, 1929, *124*, 265), discussing the isotopic effect in spectra and precise atomic weights gives the following values :—

$$O17 = 17.0033 \pm 0.0008.$$
$$H = 1.00777 \pm 0.00002.$$
$$He = 4.0022 \pm 0.0004.$$

Birge, however, now assigns to He the value 4.0018 which Giauque remarks.

It is to be expected that the atomic weights (individual mass values) should fit into the packing scheme as developed more fully by Aston, which is now well known. We have to be on the lookout for exceptions to the rule so that these matters are not quite settled in every detail.

NEW STRIKE OF NATURAL GAS IN WESTERN ONTARIO.

Considerable interest is being manifested in the deep drilling carried out by the Ajax Oil and Gas Company, Ltd., and its No. 4 well in Dover Township ,Ontario. In contrast with the shallow wells of 500 or 600 feet in the vicinity, the Ajax Company has drilled this well to a depth of 3,200 feet, and on June 5 the well was "shot," bringing in a flow of natural gas. Early reports indicate that it is showing a production of 5,000,000 cubic feet of gas daily.

PETROLEUM CONSUMPTION IN CANADA.

Large Percentage Used on Farms.

The Financial Post (Toronto) has published some interesting estimates relative to the consumption of gasoline in Canada during the year 1928.

According to the Journal named, Canada consumed from 20 to 25 per cent. more gasoline than in any previous year on record, the total quantity used being in the neighbourhood of 475,000,000 gallons. The total for 1929 is expected to rise to 570,000,000 gallons, as not only are automobile registrations increasing in Canada by from 14 to 15 per cent. yearly, but the use of tractors and petrol-using machinery on farms; the increasing tourist traffic; a higher mileage per car; and the rapid development of air navigation have all taken their part in swelling the annual petroleum consumption in the Dominion. It is suggested, furthermore, that consumption is increasing at such a pace that within five years the total will reach as much as 1,000,000,000 gallons. The latest official published estimated consumption is that issued by the Dominion Bureau of Statistics at Ottawa for 1927, amounting to 365,000,000 gallons.

Calculations which have been made for the Journal suggest that the consumption of gasoline on Canadian farms last year totalled about 90,000,000 gallons, or nearly 20 per cent. of the total. During 1929, farms will probably consume about 108,000,000 gallons, and in 1930 will use more than 140,000,000 gallons. At the present rate of growth, farm machinery should maintain this ratio for many years to come, as the use of tractors is rapidly increasing by a percentage between 50 and 60 per cent. per annum. At the present time, it is believed that about 75,000 gasoline tractors and reaper-combines are in use in the Dominion, the approximate annual consumption of which is reckoned at about 1,200 gallons each, as compared with 350 for an automobile.

SUGAR CANE TEST FIELDS AND FERTILISER DEMONSTRATIONS.

By C. B. Gouaux, *Sugar Cane Specialist.*

The results of the sugar cane variety work conducted in the Louisiana sugar belt during the year 1927 on the five test fields of the Louisiana Experiment Station, which are located in representative sections, are presented in Louisiana Bulletin No. 202. In the fall of 1927, the most promising varieties were again planted in five replications of one-twentieth acre plots, giving at each place two series of sugar cane variety plots, *viz.* (1) Plant Cane; and (2) First Year Stubble. The work performed at the test fields during the past season was somewhat along similar lines as the previous year. During the regular harvesting season, the varieties on trial were carefully harvested

under proper supervision, and accurate results of field tonnages and large scall mill tests obtained.

The special work of sugar cane fertiliser demonstration was conducted as an Extension project under County Agent supervision with co-operating sugar planters. The fertiliser materials for this series of demonstrations were donated to co-operating planters by the Chilean Nitrate of Soda Educational Bureau, who co-operated in the work. The plan of three-acre demonstration used in this Extension project, is based on the results of fertiliser work over a period of years on sugar cane carried out by the Louisiana Experiment Station.

BRITISH COAL AND OIL EXPORTS IN JULY, 1929.

Exports of coal in July amounted to 5,848,000 tons, as compared with 4,883,000 tons in June, when a shortage of available shipping affected the coal export trade, coal exports in July, 1928, were 4,163,000 tons. In addition, coal shipped for the use of steamers engaged in the foreign trade (including fishing vessels) amounted to 1,454,000 tons last month, 1,361,000 tons in June, and 1,428,000 tons in July of last year. The monthly average value of coal exported this year advanced from 15s. 6d. a ton in January to 16s. 8d. in April; declined to 15s. 11d. in June, and again advanced in July to nearly 16s. 1d., as compared with an average value of 15s. 7d. a ton for the month of July, 1928. The increase in exports in July as compared with a year ago included increases in shipments to France (448,000 tons), Belgium (299,000 tons), Italy (185,000 tons), the Netherlands (108,000 tons), and Germany (101,000 tons). Sweden, Norway, and Denmark together took 153,000 tons more, and Argentina 88,000 tons more. Imports of crude petroleum amounted last month to 68.6 million gallons, in June to 45.8 million, and in July, 1928, to 53.7 million, while retained imports of refined petroleum were 128.2 million gallons last month, as compared with 110.6 million in June, and 153.5 million a year ago. Exports of British refined petroleum were 8.4 million gallons in July, 12.3 million in June, and 6.7 million in July, 1928. The quantities of fuel oil shipped for the use of steamers engaged in the foreign trade (including fishing vessels) were 19.1 million gallons last month, 22.4 million in June, and 24.4 million a year ago.

BOARD OF TRADE ANNOUNCEMENT.

The Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, exempting mercury vapour rectifiers; neodymium oxide; praseodymium oxide; and yttrium oxide from Key Industry Duty from 20 August, 1929, to 31 December, 1930.

The Treasury Order will shortly be published by the Stationery Office.

CHAIN STORE UNITS IN CANADA.

The Canadian Business Research Bureau has estimated that during the year 1929 there will be 1,000 new chain store units established in Canada, that 700 were established in 1928, and that the number which were in operation on January 1, 1929, was 3,700. According to this report, there were on that date 1,670 stores included in the grocery chains, 297 selling drugs, 237 meat stores, 223 variety stores (5c-$1.00), 217 cigar stores, 149 candy stores, 109 cafes, restaurants and hotels, 108 bake shops, 106 shoe stores, and 15-20 other lines in each of which there were chains of from 10 to 90 units. This report did not include gasoline service stations, of which there are hundreds under chain management. The chain type of management has spread through many fields and there are now chain stores selling furs, radios, musical instruments, hardware, tyres, soft drinks, clothing and furniture. At the beginning of 1928 there were 77 department stores in Canada under chain management.

Independent stores in Canada, particularly groceries, have met the invasion of the chain store by the formation of associations of retail dealers. Among the more important of these is the group known as Victoria Independent Stores. It would not be difficult to pick out 50 such stores which are now doing an average business of $20,000,000 a year each. Macy's does a business of $88,000,000 a year. Filene's, which is not a department store, but a specialty shop, with only about 10 per cent. as many different classes of goods as Macy's, and located in Boston, with only 700,000 population, has sales of more than $29,000,000 a year. Such a chain would have total sales of one billion dollars or more a year. That volume of sales would be comparable to that of the General Motors Corporation with sales of $1,058,153,388, or perhaps even to that of the United States Steel Corporation whose sales in 1926 were

$1,506,076,090. A single one of the chains of departments in such a group might sell $50,000,000 worth of goods a year, or more. Some of the chains of departments will take the entire production of the most scientifically organised factories. Others will take enough of a factory's production to stabilise its business and make the tremendous economies of real mass production possible. The manufacturing costs of the goods will be reduced considerably. The distribution costs will be cut 25 per cent. or perhaps 50 per cent. The lion's share of these savings will go to the consumer in lowered prices, yet the total profit on sales will be higher than any department store or chain of stores now enjoys.

SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

The London School of Hygiene and Tropical Medicine (Division of Tropical Medicine and Hygiene) announces the following examination result :—

(86th Term. March-July, 1929.)

Passed with Distinction. — S. Taneja (Winner of " Duncan " Medal), Gammal, M. A. A. El; Lowther, A. H.; Navasquez, S. J. De; Scanlon, R. W.; and Yenikomshian, H. A.

Passed. — Aich, J. C.; Aitchison, W.; Allen, K. W.; Arndt, G. H.; Atta-Ullah, sh; Baboo, S. M.; Battson, A. A.; Bernard, A. V.; Bermingham, H.; Buntine, R. M.; Cassidy, F.; Chadha, M. S.; Clay, D. B.; Evans, W. G.; FitzGerald, G. H.; Fleming, A. McK.; Fraser-Smith, A. E.; Goh, K. K.; Henderson, R. B.; Henry, G. H.; Husini, M. El; Jones, R. C.; Kwei H. W.; Lawlor, M. K.; Lowe, G. H.; Mahon-Daly, F. O. W. A.; McLagan, F.; MacNab, R. A.; McCarthy, D. D.; Mitra, S. K.; Mottet, L. H.; Murray, C. P.; O'Connor, H. M.; Pinson, R. F.; Simpson, T.; Smyth, J. T.; SSoodeen, C. E.; Stuart, R.; Thapar, D. Rr.; Ullah, M. A.; Unnithan, G. N., and Vost, K. C.

LEAGUE OF NATIONS REPORT ON RADIUM AND CANCER.

The various reports issued by the Health organisation are of a highly technical nature and deal exclusively with results obtained in the treatment of cancer of the womb by radiological methods, X-rays and radium being included in this category. The results relate for the most part to patients treated between the years 1918 and 1923, and special emphasis is placed on what are called " five-year cures," that is to say, absence of the disease five years after the beginning of treatment.

Though variations occur in the records of the three different centres, it appears, from the tables published, that five-year cures have been obtained in about 40 per cent. of early or " operable " cases treated by radium, but that the percentage of such cures in all the cases—that is to say, in operable and inoperable cases—is very much lower. The earlier the treatment the better the chance. It must be pointed out, however, that progress in knowledge about treatment by radium has been very rapid, and that the results for the later years are more satisfactory than those for the early years. In Paris, five-year cures were only 10 per cent. for those treated in 1919. They were 30 per cent. for those treated in 1923.

A most interesting feature of the report is the table shown by the Radium Institute at Paris, in which progress of the five-year cure cases is given beyond the period of five years. This table shows that no recurrences took place and that such deaths as occurred among the group were not due to cancer.

Emphasis is laid, in the report, on the necessity for a proper classification of the cases and for a campaign to warn women about the importance of early diagnosis and early treatment. In a memorandum on the organisation required for an effective campaign against cancer of the womb Professor Regaud, of Paris, insists that consultation centres should be many in number whereas treatment centres should be few : " It will be necessary to prevent the departments established for detecting the disease from becoming centres for radium treatment, and it will not be easy to do this." The reason is that treatment is of so highly technical a character that success can be looked for only when it is given by persons possessed of special knowledge and training and having at their disposal special methods and facilities.

MODERN METHODS OF UTILISING COAL.

By the low temperature carbonisation methods each ton of coal yields 14cwt. of coalite (smokeless fuel), 18 gallons of crude coal oil, 2½ gallons of petrol, and 4,00 cubic feet of pure gas.

DEATH OF PROF. DR. S. B. SCHRYVER.

Dr. Samuel Barnett Schryver, Professor of Bio-Chemistry in the Imperial College of Science and Technology, died at his home, 32, Bolton Gardens, London, S.W.5, on August 21.

Professor Schryver, who was born in London in 1869, the son of the late Lewis Schryver, was educated at University College Leipzig, and was first appointed assistant lecturer and demonstrator of chemistry at Liverpool. He next returned to London as Lecturer on Physiological Chemistry at University College, and was also appointed Chemist to the Research Institute of the Cancer Hospital, where he did much sound and careful work, which has been put on permanent record in a number of published papers. In 1913 Dr. Schryver was chosen from a large number of applicants to fill a vacancy on the assistant professorial staff of the Imperial College, and in 1920 he was appointed Professor of Bio-Chemistry at the College. He was elected a Fellow of the Royal Society last year.

THE INKS, DYES AND COLOURS INDUSTRY IN CANADA, 1928.

Production from the inks, dyes and colours industry in Canada during 1928 was valued at $3,334,168, or $112,491 above the value reported for 1927, according to data compiled by the Dominion Bureau of Statistics at Ottawa.

SOCIETY OF GLASS TECHNOLOGY.

ARRANGEMENTS FOR MEETINGS FOR THE SESSION 1929-30.

1929—
- October 16—Sheffield.
- November 20—Leeds.
- December 18—London.

1930—
- January 15—Sunderland .
- February 19—Sheffield.
- March 19—Stourbridge.
- April 16—Sheffield (Annual General Meeting.)
- June 3, 4 and 5—London. (Joint Meeting with the Deutsche Glastechnische Gesellschaft.)

The Joint Meeting with the German Society of Glass Technology will probably take the place of the usual meetings in May and June.

NOTICES OF BOOKS.

A School Chemistry. By ARTHUR BROOKS. Pp. xv + 312. London: University of London Press, 10-11 Warwick Lane, E.C.4. 1929. Price 4s. 6d.

Of elementary textbooks on chemistry how many are really satisfactory? Many fall far short of perfection and this has induced those who teach the science to write their own books for their classes. Each author may remedy some defect in an earlier work whilst he himself may introduce one or more undesirable features into his own volume. It is therefore very refreshing to read *A School Chemistry* like Mr. Brooks has written and find that the author has avoided the major defects of earlier writers of elementary textbooks and has written a very useful work for those engaged in science work in secondary and technical schools.

The book is rather more than an elementary textbook although it pre-supposes very little acquaintance with chemistry. The first three chapters are devoted to the operations involved in preparing pure substances and include a large number of observations and remarks upon general laboratory procedure. The next five chapters describe the "pillars on which chemistry stands," *i.e.*, the laws, theories and other generalisations, together with the evidence in their support. Then there follows a detailed study of the common non-metallic elements and their chief compounds (ten chapters). Four concluding chapters describe the typical metals and their salts and the appendix includes logarithm tables, etc.

The book as a whole is above criticism although there are one or two minor points which might with advantage be altered in a second edition (which should be required soon). One or two mis-spellings have crept in (*e.g.*, *hydrochlorine*, p. 162), and the apparatus described as used for making nitric oxide, and those for nitrogen peroxide and phosphine are not the most convenient. It must, however, be admitted that the sketches are otherwise good and remarkably clear. The author has a partiality for Drechsel bottles and Ramsay burners and uses them wherever they present any advantage.

Practical details for carrying out a large number of experiments are given and the book offers a large number of suggestions to those engaged in teaching chemistry. Even volumetric analysis has been brought in to

assist the student in acquiring a clear conception of equivalent weights.

The author has also introduced four good plates in addition to the hundred illustrations in the text, so that the book is in every way entirely suitable for students in secondary schools and technical colleges.

J. G. F. DRUCE.

NEW ONTARIO GEOLOGICAL REPORTS.

Part IV of the *Thirty-seventh Annual Report* of the Ontario Department of Mines (1928), just issued, contains the following Geological Reports by surveyors in the service of the Provincial Government:—

Gold Deposits of Woman, Narrow and Confederation Lakes, District of Kenora (Patricia Portion). By E. L. Bruce.

Lake Savant Area, District of Thunder Bay. By E. S. Moore.

Geology of the Beardmore-Nezah Gold Area, Thunder Bay District. By Geo. B. Langford.

Huronian Gold Mine, Moss Township, District of Thunder Bay. By R. J. Watson.

Platinum-Bearing Nickel-Copper Deposit on Lower Shebandowan Lake, District of Thunder Bay. By R. J. Watson.

Copies of the Report in question can be consulted by *Chemical News* readers at the Canadian Building, Trafalgar Square, London, S.W.1., or at the Ontario Government Office, 163, Strand, London, W.C.2.

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New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

24,436.—Bataafsche Petroleum Maatschappij.—Manufacture of anhydrides of organic acids. August 9.

24,038.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges).—Manufacture of anhydrous sodium sulphide. August 6.

24,308.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.). — Manufacture of concentrated acetic acid. August 8.

24,180, 24,181.—I. G. Farbenindustrie Akt.-Ges, and Johnson, J. Y.—Production of dyestuffs. August 7.

24,303.—I. G. Farbenindustrie Akt.-Ges. and Johnsön, J. Y.—Production of vat dyestuffs.

Specifications Published.

286,227.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of substantive trisazo dyestuffs.

Abstract Published.

314,020.—Anthraquinone derivatives. — I. G. Farbenindustrie Akt. - Ges., Frankfort-on-Main, Germany.

...*Anthraquinone-β-carboxylic acids and esters thereof* are made by treating an anthraquinone-β-aldehyde in tbe presence of an alkali cyanide with hwater, an alcohol, or a phenol, and oxidising the leuco compound thus obtained. In examples, anthraquinone-β-carboxylic acid is made from the β-aldehyde and aqueous sodium cyanide, the methyl and ethyl esters from anthraquinone-β-aldehyde, potassium cyanide and methyl and ethyl alcohol respectively, 1-iodoanthraquinone-2-carboxylic acid methyl ester from 1-iodoanthraquinone-2-aldehyde (obtained from the 1-amino-2-aldehyde), potassium cyanide and methyl alcohol and 1-aminoanthraquinone - 2 - carboxylic acid methyl, ethyl, and phenyl esters from the corresponding aldehyde, potassium cyanide and methyl and ethyl alcohol and phenol respectively.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

503,782.—Illustration of a pin with a crooked head.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—Kay Brothers, Ltd., St. Petersgate Mills, St. Petersgate,

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[NOTE.—*We regret that a portion of Prof. W. E. Dixon's article on Physiology was in error printed in wrong sequence last week.*—ED., CHEMICAL NEWS.]

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION I.—PHYSIOLOGY.

PHYSIOLOGY THE BASIS OF TREATMENT.

Address on July 24, by PROF. W. E. DIXON, M.A., M.D., F.R.S., President of the Section.

(*Continued from page 134, col. 1.*)

But it is not with medicine as a whole that I wish to direct your attention to-day, but only with that part of physiology which forms the basis of treatment.

When the sciences of physiology and pathology a century ago passed from the realms of natural history to deduction and experiment, they naturally attracted the more original and eager minds in medicines, and the text of the writings of the nineteenth century deals with changes in structure and function. Treatment became neglected, the old shibboleths and rituals of treatment which had held sway for centuries were discarded, and there was nothing with which to replace them. In the middle of the last century S. Skoda and K. Rokitansky (in Austria) perfected a system of physical diagnosis which has had a practical bearing on medicine ever since. Skoda made many experiments with drugs on the patient without any expectation of producing benefit; the patients were not improved and Skoda thought it mattered little how the patient was treated. It is right to say, however, that these experiments were deficient in many respects according to modern views. At this period the Vienna School held a prominent position in scientific medicine and the new doctrine rapidly spread. The physician studied disease in the patient; its beginnings, its progress, its effects, and the scars it left, as shown at autopsy. Scientific medicine looked askance at treatment; textbooks spent many pages in describing the symptoms, diagnosis, and pathology of disease, but two or three lines dismissed the treatment: and even in our times the 'scientific' physician is apt to be a diagnostician rather than a healer. The study of disease as an entity was the object aimed to autopsy. That most admirable and popular textbook of medicine by the late Sir William Osler was typical of the textbooks of the time. Dr. Simon Flexner once told me that Osler's book, characterised by its almost complete lack of indications for treatment, was largely responsible for the Rockefeller millions given to medicine. The textbooks of the period told with considerable precision what was happening in the body during disease and what was likely to happen, but little or nothing on prevention. This state of affairs was unavoidable; there was no specific treatment, there was no science of treatment, for such a science could only come into existence when physiology and pathology had reached some degree of precision. Diagnosis was then and is now far ahead of treatment; diagnosis is often accurate where there is no satisfactory treatment and yet diagnosis is only a means to the end.

The science of treatment or pharmacology is therefore relatively new; it includes knowledge of all kinds dealing with the treatment of disease or alleviation of suffering. It is the climax of physiology and pathology, devised to subserve a practical end, and forms an important part of the great biological topic of the influence of conditions on the living organism. Few drugs now exist the mode of action of which is not understood, and the goal is not so far distant when it will be possible to introduce into the animal economy a factor which will exaggerate or retard the function of any tissue or collection of cells in the body, leaving the others unaffected; and most of these results have been obtained by the methods used in experimental physiology.

The first object of science is to ascertain facts: certain facts in physiology are relatively easily ascertained, those for example, which involve the behaviour of ferments of isolated cells or of tissues and which require well-known chemical or physical methods. Other facts involving the physiology of the whole organis mare more difficult to interpret, though they are the basis of the therapeutic side of medicine. More and more is physiology being regarded as the application of physics and chemistry to the phenomena of life. It may, of course, be argued, as I believe Descartes did first, that the body of a living man is a machine, the actions of which are explicable by the known laws of physics and chemistry: and that, therefore, the correct way to study physiology is by applying these sciences to the cell. I am by

academic research on these lines which is published annually, often by workers with litttle biological knowedge or training, but it surely should not precede the more immediate aspects of the subject. The modern attitude is expressed by a distinguished young biochemist who in reviewing a well-known book on chemo-therapy in 1928, asks: 'Might not the time and resources spent on chemo-therapeutic research be diverted more profitably to the study of chemical and physical mechanism?' The same attitude is reflected in the awards of Fellowships and Scholarships for Medical Research. Formerly all the recipients were primarily biologists with a medical training: now a medica-biological training is unusual. Physiology in the broad sense in which it was used by Claude Bernard and Huxley has given place to a new physiology of physico-chemical reactions: I might go beyond this and say that physiology is getting further and further from practical medicine, and this is the more regrettable as most of the Chairs in Physiology are connected with the Medical Schools and because the science of treatment is largely dependent on experimental physiology. Prof. J. S. Haldane clearly had this in mind in 1928 when he wrote: 'We may say without serious misrepresentation that the official present-day view of physiologists is that physiology . . . aims at investigating the physics and chemistry of life, and might properly be called biophysics and biochemistry.'

Biology has lost ground as an educational subject in the last twenty years; yet few, if any, sciences cultivate the powers of observation to the same degree. Universities, like London, in which biology was once compulsory for all undergraduates reading science, have now made it an optional subject for science degrees; so that it is not surprising to find not only the general public but men who have had a scientific training living in complete ignorance of the elementary laws which govern animal life, including their own. Can it be wondered at that we, as a nation, are the prey of the charlatan and food vendor? Ought not all educated people to know enough of biology to understand something of its methods and to have grasped its fundamental truths, if it be but to protect themselves? In our education and culture in this respect we fall short of many European countries and of America.

No branch of experimental biology has received less consideration in Great Britain than that of pharmacology; it is also the most neglected branch of medicine, and although the object of medicine is the healing of the sick, it is amazing that medical schools in Britain, often equipped with all other modern laboratories, lack departments of therapeuticsfl I was once asked at a meeting, by a leading medical man, what has pharmacology ever done? The answer is, of course, that it has formulated and brought reason and knowledge into treatment of the sick; so much did it impress that great pathologist, Ehrlich, that he left his sera and turned his attention to drugs, and with the unlimited resources at his disposal, gave the world, amongst other drugs, salvarsan: so much did it impress the brilliant chemist, M. Fourneau, that he has confined his studies to those of drugs, a study which has resulted in the synthesis of many valuable arsenica compounds and dyes. In America many centres, including the Rockefeller Institute, have turned to the study of drugs; and Italian pharmacology is doing the same.

I have heard it said by a leading official of our Ministry of Health, speaking to panel practitioners, that they, in the Ministry, do not want stereotyped prescribing in treatment. Surely there was never such nonsense. If there is a best treatment, let us have it whether it is stereotyped or not. In this respect the British Medical Association has given the profession a lead and shown by the experience of a great number of doctors that there is a best way of treating varicose ulcer in which the patient gets well quicker than by other ways, an advantage both to the patient and to the community who have to keep him whilst he is unfit for work.

The British physician is a skilled diagnostician and is in the forefront of all that pertains to this subject. The literature is so extensive that it is impossible for the average clinician to do more than this. But how few of them do, or perhaps the more correct word is 'can,' occupy the same time in the study of recent advances in general therapeutics? The successful physician has, generally speaking, to be content with such references to treatment as are to be found in clinical reading. The general physician must always be a necessity for diagnosis; but the details of treatment of patients will, I believe, in the future be handed over to those who have made a special study of the treatment of that particular group of diseases from one of which the patient is suffering. This is already the position in

tuberculosis.

But the advent of institutions for experimental therapeutics is upon us, though Britain has taken little part in the movement. In this connection we welcome the magnificent buildings of the University of Capetown, and when the new hospital with its medical school is completed I confidently anticipate that adequate accommodation will be provided for that important branch of applied physiology, pharmacology, and that this will include laboratories of physiology and organic chemistry, which must be in close and direct association with the wards. The enormous importance of one branch of treatment to Africa, chemotherapy, I will refer to later.

From what has been said, it is not surprising that British pharmacology should be so much behind that of other countries in the production of new curative remedies; practically all come from abroad; I may mention ephedrine for spasmodic asthma, liver extract for pernicious anæmia, insulin, the organic arsenicals, the dyes such as 205, the new anæsthetics local and general, hypnotics, and many others.

It has been often stated that the action of remedies may be best determined by experimenting with them on healthy men. This is not true; quinine is used to treat malaria, yet not one of the subjective symptoms induced in man has the remotest connection with its curative properties. The same is true of the use of the iodides in syphilis and salicylates in rheumatism. The experiments of Joig and his pupils in 1825 with camphor, digitalis and other drugs on healthy men added nothing of value to pharmacology. Subjective sensations are, it is true, produced, which are erroneously attributed to the drug which has been taken. The late Dr. Rivers and myself were nearly the dupes of such an experiment whiih I will give in full because it illustrates the imaginary sensations and eeects produced by S. Hahnemann and his pupils, by Perkin with his retractors and by more modern physicians with their mystic apparatus.

Our experiments were made on healthy men under a regular regime as regarded sleep, exercise, and diet. The men were practised with the use of the ergograph during several weeks at the same hour daily, until their output of work was constant. We found that the administration of a dose of caffeine dissolved in water one hour before the experiment greatly increased the output of work for that day. This was repeated on several occasions, always with the same result, and we naturally regarded the effect as due to the caffeine. This, however, was not the case: the effect was due to the ritual of taking a drug; the drug day assumed an enhanced importance in the mind of the operator and the mental effect sometimes referred to as suggestion was principally responsible. We had no difficulty in showing that water made bitter with a trace of quassia or other simple bitter had a similar effect.

Few, if any, experiments made on man without the most careful controls are of any real value. Properly controlled experiments have been made, however, with many substances. Precise experiments, for example, have been made both in Germany and America with bromides in epilepsy. In these experiments half the epileptics were given potassium chloride and the other half sodium bromide; after several weeks' use the bromide had decreased the number of attacks, whilst the chloride had no distinct action.

Chemo-Therapy.

At one time hopes ran high that the chemical structure of the molecule might indicate pharmacological action. During the last fifty years many laborious researches have been conducted with this object; to modify the molecule that it may conform to some required action. But the mystery remains as mighty as ever. It is most probable that subtle energy factors binding the molecule—factors not displayed in a formula—control the action; certain it is that drug action is not determined directly by chemical combination with body constituents, but rather by delicate physical processes such as those of adsorption, solution, and surface tension. Chemists have as yet not even determined the requirements of the molecule for the production of colour sensation. On the other hand, slight alteration of a molecule already complicated and with a known action has led to the production of many useful compounds, and not infrequently we may forsee the type of action which will occur under such special conditions. Considerations of this nature have led to the synthesis of the new local anæsthetics, antiseptics, antipyretics, diuretics, tropeines and other useful substances.

But chemistry has taken yet a further step in its assistance given to medicine in the development of that branch of science to which the name chemo-therapy has been given. Ehrlich noticed that colouring matters injected into the living organism

had a selective affinity for certain cells, and he believed that it might be possible by making use of this property to select suitable substances which would destroy the causal agents of disease, parasites and microbes, and leave the tissues of the host uninfluenced.

Parasites causing disease in man may be crudely divided into worms, protozoa, and bacteria. Chemo-therapy, that is specific therapy of infectious disease, has had marked success in curing disease due to parasites in the first and second of these groups; this diseases are found mainly in the tropics. It has obtained much less success in the third group.

Diseases due to protozoa have an especial significance in Africa, and it is appropriate that in this meeting some reference should be made to that area of tropical Africa occupying more than a million square miles in which one form of these, namely, trypanosomes, produce their ravages.

Disease of man produced by trypanosomes is confined to tropical Africa and some of the adjacent islands. But an enormous belt of country stretching from Rhodesia northward to the Bahr el Ghazal, and from the Cameroons westward to Tanganyika is inhabited to a greater or less degree by the infected tsetse fly. Two forms of trypanosomes are known to infect man, *T. Gambiense*, which is especially common in the neighbourhood of the two great lakes, Victoria and Tanganyika, and northward of these to the tributaries of the Nile. The other, *T. Rhodesiense*, is mainly found in the country surrounding Lake Nyasa, Portugese East Africa, Nyasaland, and Rhodesia : this form is more rapidly fatal than *T. Gambiense*, and its treatment is less satisfactory. Epidemics may occur in different districts from time to time : thus in 1900 an epidemic occurred in the Belgian Congo in the neighbourhood of Kisantu, in which two-thirds of the population succumbed within ten years. It is probable that the population on the northern border of Lake Victoria Nyanza had existed for generations without trypanosomes (sleeping sickness), although Glossina, the carrier, was plentiful. It then happened that some migration of natives, possibly caravan porters from the Congo, introduced the trypanosome, and a terrible epidemic of *T. Rhodesiense* swept the country in 1898, spread round the Lake and killed about 300,000 natives. The natives and their cattle were removed in 1909 and the infested district was left to the fly. Dr. Duke points out that the *Glossina Palpalis* had hardly diminished in the succeeding eight years and he regards wild game as a trypanosome reservoir; he showed in 1911 that the situtunga serves as a mammalian host for the trypanosome as well as man, in the same way as N'gana is carried by many species of game; in this way the fly retains the trypanosome which causes sleeping sickness. In Uganda, at any rate, lizards and crocodiles form the chief sources of food for *G. Palpalis*.

T. Gambiense is transferred by *Glossina Palpalis*, *T. Brucei* by *G. Morsitans* and *Pallidipes*, and *T. Rhodesiense* by *G. Morsitans*. Innumerable other instances might be given of its ravishes in the whole of the Congo, Cameroons, and other parts of Africa. Besides the human form of the disease another tsetse fly is responsible for the trypanosomes of domestic animals, including horses and cattle, *T. Brucei*, which produces the disease N'gana, so that in infected districts draft animals and dairy cattle cannot exist.

Trypanosomiasis is one of the most serious of all tropical diseases and affects both man and beast; it is a scourge which renders vast tracts of land practically uninhabitable and which takes its death toll often in thousands and occasionally even in hundreds of thousands, and yet it is a disease which I believe should be curable if not preventable. The problem is one of wide interest and importance — scientific humanitarian, and economic. The members of two groups of chemica lsubstances excel all others in their curative value in trypanosomiasis and spirochætosis; these are the organic arsenical compounds and the dyes.

(To be continued.)

UNIVERSITY OF MANCHESTER.

Faculty of Technology.

PROSPECTUS OF UNIVERSITY COURSES IN THE MUNICIPAL COLLEGE OF TECHNOLOGY,

MANCHESTER.—SESSION 1929-30.

We have to acknowledge receipt of the full Prospectus for the Session 1929-30, which gives a good idea of the numerous activities of this great educational centre.

The Manchester Municipal College of Technology has developed from the Manchester Mechanics' Institution, founded in 1824, in Cooper Street, until to-day it is of University rank and attracts students from

all parts of the world. The Owens College, which was opened in Manchester in 1851, has grown into the Victoria University of Manchester. A Faculty of Technology in the University was established in 1905, with the Principal of the then School of Technology as Dean of the Faculty, and with the heads of the Mechanical and Electrical Engineering, Applied Chemistry, and Architecture departments of the School of Technology as Professors of the University. The Department of Architecture is now confined to Owens College, and the head of the department of Textile Industries as a Professor of the University is now added to the Faculty, together with a number of the College lecturers who are also lecturers in the University. The Dean and the Professors are members of the University Senate. The University Courses provided by the College of Technology lead to the degrees of Bachelor and Master of Technical Science and Doctor of Philosophy (B.Sc.Tech., M.Sc.Tech., and Ph.D.).

THE MECHANICS' INSTITUTION AND THE COLLEGE OF TECHNOLOGY.

The Mechanics' Institution was originally housed in the first building expressly designed for the purposes of a Mechanics' Institute. But the first of these Institutes, which owed their existence to the enlightened and far-seeing philanthropy of such men as Dr. Birkbeck and Lord Brougham, was established in London in 1823. During the greater part of the nineteenth century these Mechanics' Institutes afforded almost the only means whereby those who suffered from the inadequate provision of elementary education before the Education Act of 1870 were able to make up for the deficiencies in their early training. The Institutes were nowhere so successful or so well established as in the North of England, and especially in the great manufacturing districts of Lancashire and Yorkshire.

The Manchester Mechanics' Institution was one of the most flourishing examples of this form of educational effort. Its influence on the life of the city was great and lasting. It was the pioneer of many important movements. Its activities included the provision of popular lectures by eminent men in science and literature; it arranged industrial exhibitions, exhibitions of fine art, and popular concerts of a refined and elevating character; and it made experiments in secondary education.

In 1857 the success of the Institution had been such that an appeal was made for the means still further to increase its usefulness. A new building was erected in David Street (since known as Princess street), and in this and other neighbouring buildings the Institution was carried on until 1902. About the year 1883 the help of the City and Guilds of London Institute enabled the scope of the work to be enlarged; a new representative Governing Body was formed, and the name of the Institution was altered to that of the Manchester Technical School. Specialised senior courses of instruction for day students were organised in Chemistry, in Engineering, and in the Textile Industries; and in the year 1886 the work of the School was extended to include also a Manual Training School. This was the first serious attempt made in England to provide for boys between thirteen and fifteen years of age a department for Manual Training on the lines of the American Manual Training Schools, and having much in common with the Junior Technical Schools of to-day.

The City Council of Manchester was quick to take advantage of the Technical Instruction Act of 1889, and of the further Act of 1890, which placed at the disposal of Local Authorities an Imperial Grant of nearly £800,000 a year for the promotion of Technical Instruction. On the passing of these Acts the Governors of the Technical School decided to transfer it to the Corporation, and this transfer was egected in 1892. Meanwhile the Royal Jubilee Exhibition had been held in Manchester in 1887 with the declared object of devoting its proceeds to the development of Art and Industry. The proceeds of the Exhibition exceeded £43,000, and of this sum nearly £14,000 was contributed towards the cost of erecting the new Technical School which the Corporation undertook to build.

A Committee of Enquiry visited the Continent of Europe on various occasions for the purpose of studying the chief technological institutions and their arrangements and equipment. In 1898 the United States were visited for the same purpose by the late Mr. J. H. Reynolds, who, as Secretary of the Technical School, Director of Higher Education for the City, or Principal of the School of Technology, directed the affairs of the School from 1879 until 1912 and to whose wise forethought and strenuous character, more than to any other single cause, the present College of Technology owes its existence.

The legateees of the late Sir Joseph Whitworth, who had previously founded and equipped the Textile Department of the School in Peter Street, gave a sum of £5,000

and a plot of land, 6,400 square yards in extent, formerly occupied by the engineering works of Sir Joseph Whitworth & Co., Ltd., to promote the establishment of the new Technical School. The Corporation added to this site a further area of 900 square yards, and on July 20, 1895, the first sod was turned by the late Sir James Hoy, Chairman of the Technical Instruction Committee and afterwards of the Education Committee of the City Council. The Prime Minister, the Right Honourable Arthur James Balfour, M.P., opened the new building on October 15, 1902. In the course of his address he referred to the School in the following terms : " This building is perhaps the greatest fruit of its kind, the greatest fruit of this kind of municipal enterprise in this country. . . . Nobody can go over this building, observe its equipment, study even in the most cursory manner the care which has been devoted to it, without feeling that the Corporation of this great city have set a great example worthy of the place they held in Lancashire, worthy of the place they hold in Great Britain."

Recognising the importance of the new buildings and the equipment of all departments, together with the high range of instruction thus made possible, and the steady increase in the age and attainments of the day students, the City Council decided in 1901 to change the title of the School to that of " The Municipal School of Technology, Manchester," and to place at the head of each of the more important departments a Professor or Director. In 1918 the title was changed from " School " to " College." The value of the site, building, and equipment of the College of Technology (including the separate building, completed in July, 1908, for the technology of dyeing, bleaching, printing, and finishing of textile goods, and for the technology of paper manufacture) amounts to upwards of £870,000. The buildings and the greater part of the equipment are the property of the Manchester City Council, and the annual expenditure of the City Council on the maintenance of the College constitutes the greater part of the City's contribution to the cost of university education in Manchester.

In 1912 the Board of Education volume of " Reports from those Universities and University Colleges in Great Britain which are in Receipt of Grants from the Board of Education," included for the first time the then School of Technology among the University Institutions of the country.

THE OWENS COLLEGE AND THE UNIVERSITY OF MANCHESTER.

The Owens College was founded pursuant to the provisions of the will of John Owens, of the City of Manchester, merchant, who died in 1846, leaving the sum of £96,654 for the foundation of the College. The greater part of this sum was invested to form an endowment for the maintenance of the College, which was opened in 1851, at a house in Quay Street, Manchester, formerly the residence of Richard Cobden. The government of the College was originally vested in the trustees for educational purposes under the will of John Owens. About the year 1870, the buildings in Quay Street having been found quite inadequate for the growing needs of the College, a sum of approximately £100,000 was raised, and the new site was acquired in Oxford Road, and about the same time it was thought desirable to alter the constitution of the Governing Body. The College was accordingly incorporated under Acts of Parliament of 1870 and 1871. The new building erected on the Oxford Road site was opened in 1873. In 1872 the Manchester Royal College of Medicine was amalgamated with Owens College, and buildings for its accommodation were provided. The buildings of the College have since been greatly extended to provide lecture rooms and laboratory accommodation for various departments; the Christie Library, which now contains nearly 225,000 books; and the Whitworth Hall, opened by His Majesty the King, then Prince of Wales, on the occasion of the Jubilee of the College in 1902.

From the first foundation of the Owens College the founder had contemplated that the instruction given should be " in such branches of learning and science as are usually taught in the English Universities." Having regard to the character of the instruction so given, and to the growth of the College, application was made in 1879 for the grant of a University Charter. The Victoria University was founded by Royal Charter on April 20, 1880, and thereby Owens College was constituted a College of the University. Under clauses of the Charter providing for the admission of other Colleges satisfying certain conditions, University College, Liverpool, and Yorkshire College, Leeds, were admitted as Colleges of the University in 1884 and 1887 respectively.

In 1903 University College, Liverpool, applied for the foundation of a separate University in that city, and Owens College

BIOLOGY AND PUBLIC HEALTH.

The Industrial Application of Microbiology.

By Samuel C. Prescott.

The industrial microbiologist visualises always the two opposing potentialities of microbes, one that they may exert destructive action on materials which it is desired to conserve, the other that they may transform materials into products that it is desirable to prepare in large quantities. The general application of microbiology to the food conservation industries is an example of the first class; the development of special fermentations yielding desired substances is an example of the second class. As a matter of fact, both aspects of the problem may be intermixed, for in the development of a special fermentative process which may be of great value, the microbiologist must be eternally viligant to prevent the incursions and the destructive action of undesirable organisms.

The fundamental conception of industrial microbiology, like that of infectious disease, is that for each type of biochemical change there is a specific organism or group of organisms which activate and carry on the process. Thus yeast has long been recognised as the specific producer of ethyl alcohol, just as the anthrax bacillus is the cause of splenic fever, or the typhoid bacillus of typhoid fever. In fact, the specificity of organisfs was first worked out by Pasteur in his notable studies on fermentation processes and was later proved to be equally true for the so-called germ diseases.

In industrial processes involving the use of micro-organisms, the microbiologist must control his living material even more carefully than the chemist watches his reactions. In the first place, of course, he must have the right species or even a certain " strain " of that species for best results. For instance, some " yeasts " do not produce alcohol, but break it down; others neither produce it nor act upon it, while still others produce either large or small quantities from a given amount of sugar. Thus it is of the greatest importance to find out all about the micro-organism itself. Then the environment must be carefully controlled the H-ion concentration of the medium, its temperature, the amount of moisture present and in many cases the amount of air, being all-important factors. Finally, the right kind of food must be available, since micro-organisms are often very particular in this respect. Some kinds may act upon proteins, while others do not; one may thrive upon fats, and another will not even grow on them; a species of yeast may have absolutely nothing to do with one kind of sugar, while another species rapidly reduces it to alcohol and carbon dioxide. Thus the microbiologist has a peculiar problem all his own—the biochemistry of fermentation.

Technical applications of microbiology involving either bacteria, yeasts or moulds may be grouped conveniently into the two clases of *productive* and *preventive* processes :

A. Productive processes of Fermentation : (*a*) industrial alcohol (ethyl alcohol); (*b*) acetone; (*c*) butyl alcohol; (*d*) glycerin; (*e*) lactic and citric acids; (*f*) manufacture of yeast; (*g*) acetic acid and vinegar; (*h*) manufacture of food products such as bread, butter, cheese, sauerkraut, soy-sauce, fermented milks, and silage for animal feeding.

Closely related to these are the applications of bacteriology in leather making, retting of hemp and flax, the preparation and use of nitrogen-fixing organisms, and the action of microbes in certain types of water purification and sewage treatment.

B. Preventive processes : (*a*) food preservation; (*b*) wood preservation; (*c*) protection of fibres and textiles; (*d*) manufacture of sugar; (*e*) preparation of fruit juices and beverages; (*f*) use of disinfectants and fungicides.—*Abstract by Massachuscts Institute of Technology.*

FARADAY ELECTROMAGNETIC CENTENARY.

The arrangements initiated by the Royal Institution for the celebration of the Centenary of Faraday's discovery of electromagnetic induction have already been announced. At the representative meeting held at the House of the Institution on February 5th, 1929, the formation of two committees was agreed to, and these committees are now at work. The first, consisting of representatives of the Royal Society, the British Association, and other scientific societies, as well as the Royal Institution, is concerned with the purely scientific aspects of Faraday's work in relation to the proposed celebrations; the second committee, which has been called together by the Institution of Electrical Engineers, consists of representatives of the principal organisations of those industries which have risen in the past hundred years upon the scientific foundation of Faraday's discoveries, and is dealing with the industrial aspects of the celebrations.

The two committees are working in close co-operation; the preliminary discussions which have taken place indicate that the significance of the Centenary is very widely appreciated and that the celebrations are likely to arouse world-wide interest and support. The dates have now been fixed, and the proceedings will commence in London on Monday, September 21, 1931. Further, an intimation has been received from the British Association that their Centenary Meeting will be held in London during the week commencing September 23, 1931. These two Centenaries, with important electrical conferences and other events which are to take place about the same time, will thus conjoin to make the year 1931 a memorable one in this and every country where the genius of Faraday has borne fruit.

SMOKELESS FUEL IN THE HOME FIRE.

Medical Officer Points the Way to More Sunshine.

" It is desirable that the Government and local authorities should not only encourage the wide adoption of existing smokeless fuels, such as gas and electricity, but should also, by educational methods, endeavour to secure the general use of smokeless fuels, such as those derived from low temperature canbonisation."

Dr. C. W. Hutt, Medical Officer of Health for Holborn, from whose annual report, just published, the above extract is quoted, points out that the Public Health (Smoke Abatement) Act, 1926, although an advance on previous legislation for dealing with the smoke nuisance, is by itself inadequate to deal with the serious consequences to public health of atmospheric pollution, inasmuch as it deals solely with the emission of industrial smoke, whereas it is often the domestic fire which causes the trouble. In London, on an average, 37,000 tons of coal are burnt daily in domestic fires, contributing largely to the pall of smoke over the Metropolis.

" Atmospheric impurities," he continues, " are undoubtedly responsible in a wide measure for pulmonary diseases and, indirectly, by reducing sunshine, for diseases peculiar to childhood, notably rickets, as well as for a general lowering of the vitality. This deplorable state of affairs cannot be remedied until practical steps on a large scale are taken to deal with the all-important problem of domestic smoke."

" The general use of smokeless fuel in the home fires, as well as in industrial furnaces," concludes Dr. Hutt, " would prove a valuable and effective measure of lessening smoke and fog in town atmospheres."

GENERAL NOTES.

NEW MEMBERS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

At a general meeting of the Royal Institute of British Architects, held on March 18, the following members were elected :—

Fellows—Bradshaw, H. C.; Cable, C. J.; Irwin, L. F.; Myer, Lieutenant-Colonel G. V.; Steele, H. R.; Stevenson, R. K.; Troup, Major R. J., M.A.; Mitchell, C. T.; Wilson, F. C.; Taylor, T.

Associates—Alexander, A. G.; Aspland, A.; Ayerst, C. T.; Banks, P. H., P.A.S.I.; Beale, E. H.; Begg, K. A.; Bertram, S. N.; Brown, J. S.; Brown, R. N.; Butling, G. A.; Cadman, H. G.; Carr, F. H.; Carr, T.; Cartwright, T. N.; Cobb, A. R.; Cochrane, J. B.; Coleman, J. J.; Daniel, T. M.; Edwards, A. S.; Hall, D.; Hamilton, A. O.; Harrison, G. S.; Howes, J. F.; Johns, B. W.; Kidd, H. D.; Law, O. W. M.; De Hunte, L.; MacGillivray, I. D.; Manderson, F. K., B.Arch.; Morant, C. A. L.; Steele, A.; Sumner, B. A.; Thewlis, E. C.; Tomkyns, H. G.; Usher, W.; Vine, C. M.; Walton, D .G.; Watson, W.; Watt, J.; Whyte, W. G.

Hon. Associate — Woodward, A. M., M.A., F.S.A.

Hon. Corresponding Member — Horta, V. P.

FALLS OF ROOF, ETC., IN MINES.

The Committee of the Safety in Mines Research Board, who are studying methods of preventing accidents from falls of roof and side, has bee ncarrying out, in addition to experimental work, a survey of colliery practice as regards the support of underground workings with a view to calling attention to the best methods and suggesting improvements where possible.

The Committee have just published their fifth Report (Safety in Mines Research Board Paper No. 55) dealing with " The Support of Underground Workings in the Coalfields of Lancashire, Cheshire and North Wales." The Committee's first four Reports related to the coalfields of South Wales, Scotland, the East Midlands and the South Midlands.

COAL AND PIG IRON.

From the information available as to furnaces in blast, it appears that the average output of pig iron per furnace in June was 4,060 tons in the United Kingdom, 5,470 tons in France, 5,900 tons in Belgium, 11,070 tons in Germany, and 16,920 tons in the United States.

FRANCE.

Coal output in June showed an advance of about 93,000 tons in the aggregate over that in May, and of 47,000 tons over the monthly average for the current year. The current June output was exceeded only on two occasions in 1928 (March and October). The high daily rate of pig-iron production in April and May was not quite maintained, although the June figure of 28,370 tons was higher than any recorded last year. Furnaces in blast at the beginning and end of the month numbered 156 and 155 respectively. The aggregate June output consisted of 27,550 tons of forge and Bessemer iron, 135,780 tons of foundry, 661,200 tons of basic, and 26,570 tons of other descriptions of pig iron.

GERMANY.

The aggregate coal output in June showed an increase over the output in May, and was considerably greater than a year ago. The tonnage mined per working day reached 527,290 tons in June, compared with 515,580 tons in May, and 469,920 tons in June, 1928. The pig-iron output in June reached a high record for this year and was exceeded only twice during 1928. The tonnage produced per calendar day was 38,190 tons, as compared with 35,970 tons in May and 33,500 tons in June of last year. At the end of the month there were 103 furnaces in blast, one less than that at the end of May. The June output included 181,610 tons of foundry and hematite, 740,830 tons of basic, 1,180 tons of forge iron, and 222,080 tons of ferro-alloys. The steel output was also high in June, the records for the past 18 months showing only two higher monthly aggregates, *viz.*, in the January of each year. Outputs per working day for crude steel averaged 56,300 tons in June, 55,930 tons in May, and 49,070 tons in June, 1928, and for finisted steel products 38,800 tons, 37,750 tons, and 36,890 tons respectively.

BELGIUM.

The tonnage of coal produced in June exceeded the May output by about 77,000 tons. The average daily output for 24.7 working days was 87,640 tons, compared with 88,460 tons in May (23.6 working days) and 90,690 tons in June, 1928 (25.8 working days). The rate of pig-iron output per calendar day (11,220 tons) was 160 tons above the May figure, but was 310 tons below the rate in June, 1928. At the end of June there were 57 furnaces in blast, a net increase of one over the number in blast at the beginning of the month. The aggregate output of steel inots and castins in June (348,700 tons) was 8,700 tons above the May output. The production of finished steel products was 294,600 tons, compared with 294,000 tons in May and 295,700 tons in April.

UNITED STATES.

The aggregate of 38,520,000 tons of coal produced in June included 33,994,000 tons of bituminous and 4,526,000 tons of anthracite coal. In the bituminous industry the daily production averages 1,360,000 tons for 25 working days, against 1,359,000 tons in May (26.4 working days), and 1,235,000 tons in June, 1928 (26 working days). The daily rates for anthracite were 181,000 tons in June (25 working days), 217,000 tons in May (26 working days), and 182,000 tons in June, 1928 (26 working days). The June pig-iron output was about 200,000 tons less than the record output in May, although the output for the first six months (21,621,000 tons) established a new record for any similar period in the past. Production per calendar day averaged 123,260 tons, compared with 125,750 tons in May, and 102,730 tons in June, 1928. Furnaces in blast at the beginning and end of the month numbered 219 and 218 respectively. Although the total output of steel ingots showed some decline in June, the daily output was well maintained owing to the smaller number of working days in the month. The daily production rates in June and May, 1929, and in June, 1928, were 195,260 tons, 195,800 tons, and 144,000 tons respectively.

MERCHANDISE MARKS ACT, 1926.

WIRELESS RECEIVING SETS, ETC., APPLICATION WITHDRAWN.

The application made for the marking with an indication of origin of imported Wireless Receiving Sets, Components and Accessories has been withdrawn and the Enquiry arranged to be held on Monday and Tuesday, 30 September and 1 October, by the Standing Committee appointed by the Board of Trade will not now take place.

Some 600 million gallons of liquid products came from the oil refineries of Great Britain in 1928.

EXPERIMENTS ON ELECTRIC FUSE LINKS AND ARCS.

In Safety in Mines Research Board Papers Nos. 38 and 39, particulars were given of experiments made to determine the pressures produced on blowing electric fuse links and striking electric arcs in closed vessels when using currents up to 1,350 amperes at 575 volts.

In collaboration with the British Electrical and Allied Industries Research Association, and with the aid of facilities granted at Stonebridge Park, London, by the London Midland and Scottish Railway Company, the experiments have been continued with currents up to 10,000 amperes at 600 volts D.C.

EXAMINATIONS: MANAGERS, UNDER-MANAGERS AND SURVEYORS OF MINES.

Examinations for first and second-class certificates of competency as Managers and Under-Managers of Mines will be held on 27 and 28 November, at Edinburgh, Newcastle-on-Tyne, Sheffield, Wigan, Cardiff and Birmingham.

The written part of an examination for certificates of qualification as Surveyors of Mines will be held at the same centres on 28 November.

Applications for the necessary forms should be made as early as possible and not later than 14 October. In order that the appropriate forms may be sent it is important that candidates should state whether they have already sat at one of the Board's examinations.

Letters should be addressed to the Secretary, Board for Mining Examinations, Mines Department, Dean Stanley Street, Millbank, London, S.W.1.

BOARD OF TRADE INDEX NUMBER FOR JUNE QUARTER.

Industrial activity in the United Kingdom in the second quarter of 1929, as estimated by the Board of Trade, was 1.0 per cent. greater than in the first quarter of 1929 and 7.5 per cent. greater than in the second quarter of 1928, the index numbers for the three periods (based on the quarterly average of 1924 = 100) being 111.4, 110.3, and 103.6 respectively.

IMPORTED MALT PRODUCTS.

It is announced that a reference has been bade to the Standing Committee set up under the above-mentionel Act by the Minister of Agriculture and Fisheries, the Secretary of State for the Home Department and the Secretary of State for Scotland, acting jointly, in respect of an application for an Order-in-Council under the Act to require the marking with an indication of origin of imported malt extract; malt flour; malt extract and cod liver oil; and malt extract blended with any other product in such a way that malt extract comprises more than 50 per cent. of the whole.

APPOINTMENT OF AGENTS IN ESTONIA.

The British Consul at Tallinn has furnished the Department with a Memorandum on the appointment of agents in Estonia.

United Kingdom firms interested in this market may obtain copies of the Memorandum on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. C.X. 8112.)

APPOINTMENT OF AGENTS IN POLAND.

The British Commercial Secretary at Warsaw has furnished the Department with a Memorandum on the appointment of agents in Poland.

United Kingdom firms interested in this market may obtain copies of the Memorandum on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. C.X. 8111.)

DEPARTMENT OF OVERSEAS TRADE.

His Majesty's Charge d'Affaires at Durazzo reports that the Ministry of Finance of the Albanian Government are calling for tenders, to be presented by the 10 September, for the supply and delivery at Tirana of the following annual requirements of quinine :—

1,250 compressed sulphate of quinine.
250 compressed bi-sulphate of quinine.
500 sugar-coated bi-sulphate quinine.
500 sugar-coated sulphate of quinine.
500 chlorohydrate of quinine, sugar-coated.

500	chocolate with quinine.
800,000	ampules of 1.00 grams. Bichlorohydrate of quinine.
300,000	ampules of 1.50 grams. Bichlodohydrate of quinine.
150,000	ampules of 0.25 grams. Bichlorohydrate of quinine.

Firms desirous of offering quinine of British manufacture may obtain further particulars upon application to the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1. Reference B.X. 5621 should be quoted.

RAPID DEVELOPMENT OF CAPE BRETON ISLAND COPPER DEPOSITS.

The Nova Scotia *Public Service News* states that work upon the copper deposits at Coxheath, Cape Breton Island, is being pushed forward by the Arno Company. The management is stated to be well satisfied with the progress being made and with the quality of the ore. At the present time mining operations are being carried on at the 360-ft. level where drifting and sinking are being done.

POSSIBILITIES OF THE PEAT LITTER INDUSTRY IN CANADA.

The time seems ripe for the establishment of a peat litter industry in Canada. Large quantities of manufactured peat litter, peat mull, and insulating material made from peat litter are imported annually into Canada and the United States from Germany, Holland and Sweden. Peat litter and peat mull of a quality equal to and in most cases superior to that which is imported into North America from Europe is found in great abundance in the peat bogs of Canada, and there is reason to believe that there are great possibilities for the development of an industry on a commercial scale.

Insulating material manufactured from specially treated litter is used in the insulation of walls, floors, and roofs of buildings, refrigerator plants and storehouses.

At present two small plants for the manufacture of peat litter and mull are under construction in Canada. One of them is situated on a 150-acre bog a few miles from St. Stephen, New Brunswick, and the other on a 100-acre bog a few miles from New Westminster, British Columbia. It is expected that both of these plants will have litter and mull ready for the Canadian market this autumn.

YIELDS PER TON OF COAL (RESEARCH STATION TEST).

Hydrogen Consumed		=	114 lb.
Fraction	0°—175°	=	88 lb.
,,	175°—230°	=	208 ,,
,,	230°—270°	=	197 ,,
,,	270°—310°	=	105 ,,
,,	310°—360°	=	208 ,,
	Pitch	=	329 ,,
Gas Benzine		=	42 ,,
Bergin Gas		=	325 ,,
Unconverted Coal		=	363 ,,
Water		=	179 ,,
Coal Ash		=	161 ,,
Loss		=	154 ,,
			2,354 ,,

As a general statement it will be recognised that the products from the hydrogenation of coal contain a greater quantity of saturated organic compounds than those obtained from low temperature carbonisation, and consequently the treatment of the oil from the point of purification should not be so intricate as is necessary for the treatment of low temperature tars.

It would appear that the chief value of the fractions will be either as a motor spirit or as fuel oil, although there are indications that certain of them may be of value as lubricating bases.

In undertaking hydrogenation investigations upon the coal seams in this country it has been necessary to carry out a great number of experiments in small experimental bombs. These experiments have been carried out in batches, the process not being continuous, and in attempting to correlate the results with those obtained in the continuous plant considerable differences have been encountered in the behaviour of various coals. Certain coals, for instance, will hydrogenate readily in an experimental bomb, have been found not to be workable in a continuous plant. In view of this it is apparent that an entirely false impression of the character of a coal may be obtained if the results are not correlated directly with continuous working.—*C. H. Lander, C.B.E.*

NEW U.S.A. STANDARDS YEARBOOK FOR 1929.

This is the third issue of an annual which has proved indispensable to all interested in any phase of standardisation in America and abroad. It is a standardisation reference book summarising and bringing up to

date current standardisation activities and accomplishments in this country and elsewhere since the 1928 edition of the Yearbook. The keen and world-wide interest in standardisation is shown by the surprisingly large sale of previous issues, of which repeated reprinting has been necessary to meet the demand.

The Standards Yearbook for 1929 is full of suggestion and data for all engaged in standardisation. The many aspects of the subject call for a concise summary for busy men who most need to keep in touch with the latest advances in the standards field. The Standards Yearbook is designed to meet this need.

A special chapter (I) tells how the various countries standardize commercial weights and measures used in daily trade in the countless transactions of everyday life.

The chapter entitled "Standardizing the Tropical Year—the Calendar" is a timely and interesting *résumé* of notable efforts to bring the natural and legal years into agreement.

A brief account of international co-operation in standardization is followed by a synoptic summary of the activities of the national standards associations of the various countries.

The Standards Yearbook should be in the personal library of all engaged in work on standards, or concerned with their application in standardization.

DEATH OF MR. THOMAS GIBSON.

We regret to announce the death, at the age of 59, of Mr. Thomas S. F. Gibson, M.I.C.E., chief civil engineer of the South Metropolitan Gas Company, which took place at his home, Normandy Lodge, Vanbrugh Park Road West, Blackheath, on Wednesday, August 28.

Mr. Gibson, who joined the Company in 1895, was at work until about a week before his death. In 1900 he was appointed works superintendent at the Old Kent Road Depot, and on the outbreak of war he was placed in charge of the large plants required for the manufacture of munitions. He had held the post of chief civil engineer since 1920.

Mr. Gibson leaves a widow, one son, and two daughters.

The funeral took place on Friday, August 30, at 2 p.m., at the Shooters Hill Cemetery.

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STAFFORDSHIRE COUNTY COUNCIL.

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EUSTACE JOY,
Clerk of the County Council.

County Buildings,
Stafford.
30th August, 1929.

New Patents

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

24,971.—Brightman, R., and Imperial Chemical Industries, Ltd.—Azo dyestuffs. August 15.

24,759.—Caro, N.—Working up oxides of nitrogen. August 13.

24,842.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.). — Manufacture of barbituric acid derivatives. August 14.

24,728.—Chilowsky, C.—Purifying gas resulting from pyrogenation of heavy oils. August 13.

24,633.—Dreyfus, H.—Treatment of organic compounds. August 12.

Specifications Published.

316,919.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.). — Manufacture of hydrogen peroxide by cathodic reduction of oxygen.

290,174.—I. G. Farbenindustrie Akt.-Ges.—Process for the manufacture of titanium compounds.

317,165.—Winter, R. M., and Imperial Chemical Industries, Ltd.—Production of carbon and hydrogen chloride.

317,168.—Croad, A. K. (Chemical Construc- Co.)—Method of and apparatus for concentrating nitric acid.

Printed copies of the full Published Specifications may be obtained from the *Patent Office, 25, Southampton Buildings,* London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

314,652.—Dyes.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Pyranthrone derivatives.—The process of the parent Specification is modified by heating polyhalogenpyranthrones with nitrogen containing carbocyclic compounds in which at least one reactive hydrogen atom is connected to the nitrogen atom, whereby several or all of the halogen atoms are substituted by nitrogenous carbocyclic residues, in the presence of copper in the metallic or combined form as catalyst in comparatively large amounts, *i.e.*, about 5 per cent. or more, calculated as metal, of the theoretically possible yield of reaction product. In examples, tri- or tetrabromopyranthrone is boiled with α-aminoanthraquinone, sodium acetate and copper oxide in nitrobenzene. The use of penta-, hexa-, or hephahalogen pyranthrones and aminoanthrones, aminopyranthrones or other carbocyclic amino compounds is mentioned.

Halogen pyranthrones are obtained by treating pyranthrone in chlorsulphonic acid with halogen.

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News,* Merton House, Salisbury Square, London, E.C.4.

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BRITISH PATENT.

It is desired to secure the full Commercial Development in the United Kingdom of British Patent No. 158,852, which relates to "Distillation of Tar," either by way of Sale or the grant of Licences on reasonable terms.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION I.—PHYSIOLOGY.

PHYSIOLOGY THE BASIS OF TREATMENT.

Address on July 24, by PROF. W. E. DIXON, M.A., M.D., F.R.S., President of the Section.

(*Continued from page* 149.)

The specific action of organic arsenic compounds really begins with some observations of Thomas on the action of atoxyl on trypanosomes. Ehrlich had previously discarded this substance because it was without direct action on the protozoon, but later he observed, like Levaditi and Mesnil, that in infected animals it had a more pronounced action than that of any other substance up to then employed. Atoxyl was, however, soon discarded as a curative remedy because it caused permanent and complete blindness in some cases. Acetyl atoxyl, known as arsacetin, which was at one time widely used, had no better fortune, and several cases of permanent blindness resulted from its use. Ehrlich's experiments with Hata, in which innumerable arsenical compounds were employed, led him to select salvarsan as the best: in this substance the nitrogen and arsenic are in the meta position and not in the para as in atoxyl. This substance as a treatment of syphilis and other spirochætal infections stands as firmly to-day as it did ten years ago; it has one drawback, it does not influence the condition of the patient if the central nervous system is attacked. By introducing $CH_2OS.ONa$ in place of one of the hydrogens in the amino group a soluble compound is produced which has displaced the older salvarsan on account of its ease of administration; nevertheless ths neo-salvarsan contains as much as 10 to 20 per cent. of unknown impurities. Other substances like tetra-methyl hexamino-arsino benzene (Arsalytoe Giemsa) have been produced which are also very efficient in spirochætosis.

It is well known now that none of these compounds act directly on the parasite (Ehrlich, Levaditi, Mesnil, and others) like arsenious acid.

$$NH_2.C_6H_4.AsO(OH)_2$$
Atoxyl (NH_2 in para position).

$$NH_2CO.CH_2NH.C_6H_4.AsO(OH)_2$$
Tryparsamide (NH_2 in para position)

$$NH_2(HO).C_6H_3.As.As.C_6H_3(OH).NH.CH_2OS.ONa$$
Salvarsan with solubilising group (NH_2 in meta position)

It was at one time thought that the action of these arsenicals depended on their solubility in lipoid substances and their subsequent oxidation to arsenic in the ionic form: but after their administration to animals no trace of oxide is found in the body. About 115 mgrms. of atoxyl per kilo can be injected into mice, but only about 2 mgms. per kilo of the corresponding oxide for the maximal sub-lethal dose. It is probable that the lipoid soluble and inert atoxyl in the pentavalent form is converted into the trivalent form which destroys trypanosomes like *arsenious acid*. *Fourneau from a great* number of experiments with different organic arsenicals concludes that their varying constitution as regards the introduction of different side-chains in the ring, and the varying positions of these relatively to one another, is the factor which determines their distribution in the organism, particularly as regards the central nervous system.

The most satisfactory arsenic compound yet discovered for the cure of trypanosomiasis is tryparsamide. It is less toxic than atoxyl and has a slightly higher therapeutic index; it has a most marked trypanosidal action in animals and has been used with some success in cases of sleeping sickness from *T. Gambiense*. One injection causes the disappearance of the parasite from the blood of man, and if the injections are repeated in courses, the cure may be complete. Like atoxyl it affects the eye: even the smaller therapeutic doses cause visual disturbance, and the risk of complete blindness is always present; perhaps as many as 30 per cent. of all patients treated with this drug suffer from some eye lesions. Tryparsamide is valuable also in certain forms of syphilis, particularly cerebral syphilis: approximately 40 *per cent. of the cases of* general paresis committed to the State Insane Hospitals in Wisconsin, U.S.A., were restored to sanity (Loevenhart). This action is probably indirect since there is no evidence to show that it is absorbed into the central nervous system more than other organic arsenicals.

All these organic arsenical compounds must be injected in order to produce a satisfactory effect; but one compound, m. amino-p. hydroxyl phenyl arsenic acid, acts upon and destroys spirochætes when taken

by the mouth (Levaditi); it is generally administered as its acetyl derivative which is known as stovarsol. Stovarsal has been largely used as a preventive to syphilis, but it is now known that it has a remarkable curative action in amœbic dysentery like emetine (Valenti), and that in cases of benign tertiary malaria it checks the attacks and prevents the return of the disease, at all events for many months.

It was at first thought that, as laboratory animals are so easily infected with trypanosomes, it should be an easy matter to determine which compounds were likely to be most valuable in the treatment of trypanosomiasis; unfortunately this is not the case, a drug may cure trypanosomiasis in one animal and not another and the crucial tests must always be made on man. Fourneau's *o*-hydroxyl-*p*-acetyl-aminophenyl arsenic acid (270) acts much better on laboratory animals as a cure for trypanosomiasis than tryparsamide, but has not proved so satisfactory as tryparsamide in the Congo for the treatment of sleeping sickness. Since the crucial test with all these compounds must be made in Africa it is obvious that the expense and difficulty of continuing such researches is enormous.

Most of the antimony derivatives corresponding with the organic arsenicals have been prepared; for example, that corresponding with acetyl-atoxyl, also m. chloro-*p*-acetyl-amino-phenyl-stibamate of soda (Heyden 471) have been extensively employed in Kala-azar and Bilhartzia. Speaking generally, they have a more powerful action than tartar emetic on such diseases as Bilhartzia, Kala-azar, and Filaria, and to some of them, like sodium antimony thioglycollate, the parasites do not become readily immune. Unfortunately the organic compounds of antimony have a toxic action on the tissues and are very difficult to administer, so that antimony tartrate or stibamine urea ($NH_2CO.NH.C_6H_4SbO(OH)_2$), a compound which has recently been prepared pure, are generally preferred.

DYES.

Many dye substances have been used in medicine; as they are readily adsorbed on to cell surfaces the concentration here is always high and the surface properties of such cells are often modified in consequence. One general principle which follows from this is that widely different dyes often possess properties in common, for example, that of antiseptic; to-day I propose to refer only to one group, the benzidine dyes.

$$NH_2.C_6H_4.C_6H_4.NH_2$$

Trypan red and trypan blue belong to this group. Trypan blue was employed by my colleague, Prof. Nuttall, in piroplasma infections in animals, with results that most South Africans are well acquainted with. Afridol violet, a derivative of diaminol diphenyl urea, and some allied dyes have also a powerful action on piroplasma.

How these substances act is not known, for like the organic arsenicals they do not kill the parasite *in vitro*. They have the property, however, of being adsorbed to the blepharoplast of the trypanosome; this adsorption is associated with diminished virulence of the parasite in infected animals, and after successive inoculations through several anifals the organ may disappear. This direct action of a drug on a tissue, causing ultimately the complete disappearance of that tissue, is so remarkable that it is worthy of notice, as it represents the first known action of the kind.

The most valuable member of the afridol-violet group so far produced was first made in the Bayer laboratory, but its composition was kept secret. It was, however, subsequently synthesised and its formula published by Fourneau, but only after long trials and infinite patience. The chemotherapeutic index of this substance has the remarkable figure of 200 to 300; and as little as 1/32mgrm. will sometimes cure mice infected with trypanosomes. Fourneau has made many allied substances and derivatives of "205," he has modified the wings of the molecule by the addition of various side-chains, sometimes keeping the wings identical and sometimes changing them by joining two different complexes through the agency of phosgene. The number of such derivatives is obviously legion, and this makes it the more remarkable that he should have succeeded in synthesising "307," which at the present time is superior as a therapeutic agent to all other dyes in trypanosomiasis.

This "307" has a remarkable action on trypanosomes in laboratory animals, being 300 times more effective than atoxyl. Its discovery has also opened a new era in therapeutics, since it represents the first chemical substance which when administered to man or animals in an infected trypanosome district gives a complete immunity to the disease for several months: it does not necessarily prevent trypanosome infection, but it prevents the effects of the disease. There is much in these experiments that suggests that we are on the fringe of a new pathology, and that our present crude

methods of preparing anti-bodies in the future will be replaced by those of the organic and colloid chemist.

In man "' 205 " has not done all that was expected of it; it invariably benefits those that show infection and enlargement of glands, that is during the early stages of the disease, and its value is also assured even when the nervous system is affected. If care is taken in the treatment and a series of injections given at not too frequent intervals to prevent the parasite acquiring a tolerance, and if the patient is kept under observation for a prolonged period of time, the happiest issue may be anticipated. " 307 " is much less valuable on n'gana in animals.

I have already referred to the disappointing results of research dealing with chemical constitution in its relation to pharmacological action, but it may be well to consider whether there is anything in common between the various substances noted and their effects on protozoa. It must be evident at once that with such widely different substances it cannot be the form of the molecule which is important so much as its side-chains or physical properties, although a large molecular weight appears to be an advantage. Many of the dyes, like flavine, fuchsin, and methyl violet, have two amino radicles in the para position, relative to the carbon atoms uniting the nuclei. The azo-dyes and the innumerable derivatives from them which have been examined by Nicolle and Mesnil, present no common features with those of the triphenyl methane group. Amino groups appear to be an important factor, but it is the position of these in the rings, even more than the character of the radicle, which determines the effect. The study of the complex butterfly-like compounds of substituted naphthalenes, such as Fourneau's " 307 " instead of simplifying our conception of the relationship between constitution and action rather increases the difficulties. In such compounds slight changes like desulphonation or demethylation entirely alter the therapeutic effect. These few examples are sufficient to exemplify the fact that the synthesis of new molecules in the hope of conforming with some pre-determined action is as yet far removed from practical science.

BACTERIAL INFECTIONS.

Tuberculosis is another problem of vast importance in South Africa, not only on account of its prevalence amongst susceptible individuals in both the European and native population, but because of its association with certain industrial diseases.

Much the most important industrial disease in South Africa is the silicosis produced in the extraction of gold from the conglomerate, both the pebbles and the matrix consisting of quartz. The gravity of pneumoconiosis depends largely on superadded tuberculous infection to which the workers have a predisposition, and in this respect crystalline silica is much more harmful than either amorphous silica or carbon. However it acts, whether by direct irritation, by its poisonous properties after solution, by colloidal action, or because it forms locally a nidus suitable for the growth of the tubercle bacillue, will be discussed at a later meeting.

The report of the Miners' Phthisis Medical Bureau, dealing with the years 1914-1926, shows that the incidence of silicosis is increasing. Of the average number of 178,000 natives employed on the scheduled mines during the year 1925-26, of whom 132,260 were employed underground, simple tuberculosis was found to be present in 556, simple silicosis in 281, and tuberculosis with silicosis in 446. The large majority of cases of compensatable disease among European miners are cases of simple silicosis; among native labourers the great majority are cases of tuberculosis, mostly without silicosis. As compared with European miners the incidence of simple silicosis among native labourers is low, which according to the report mentioned is mainly due to the migratory habits of the latter, as silicosis takes time to show evidence. It may also be noted that besides tuberculosis the mortality from Bright's disease is high in silicosis.

Workers employed in other dusty trades, such as the preparation of asbestos materials, also suffer from phthisis had occurred in five years amongst a staff of less than forty workers employed in a factory where asbestos was woven; asbestos contains about 50 per cent. of silica. The dust associated with the process of carding, before its extraction was efficient, at one time in England produced a pneumoconiosis resembling that of silicosis.

It is well recognised that a patient suffering from tuberculosis who is placed under treatment, will, for a time at least, improve in health, no matter what drugs, vaccines or " specialities " may be employed. The beneficial result is due, in this as in other disease, to efficient nursing, to the regulation of food, exercise and sleep, and to light and fresh air. If only this effect were clearly recognised the number of " treatments " in vogue for this common disease might be

diminished. The enthusiastic physician sometimes begins the new treatment as soon as the patient esters his wards, and he is apt to regard the benefits which may follow as due to the special treatment. General hygienic measures are of primary importance in treatment, and it is not until all the beneficial effects which are known to ensue from these have been exhausted that the physician has any right to ascribe an effect, beneficial or otherwise, to a special treatment.

Drugs are employed in tuberculosis either with the object of attacking and preventing the growth of the tubercle bacillus or other organisms with which the disease may be associated, of neutralising poisonous toxins, or of relieving symptoms. It is with the first group that I am now concerned. Two groups of organic compounds are especially remarkable for their chemo-therapeutic action on bacteria. The first group has the quinine complex; qninine is the methyl-ester of cupreine and it can be redneed by nascent hydrogen to form hydrocupreine. The following table shows the effect of two derivatives of hydrocupreine in arresting the growth of certain micro-organisms.

	Ethyl hydrocupreine (optoquin)	Iso-octyl hydrocupreine (vuzin)
Diphtheria bacillus	1 in 100,000	1 in 750,000
Pneumococcus	1 in 400,000	Negligible
Staphylococcus	1 in 500	1 in 16,000
Streptococcus	1 in 1,000	1 in 80,000

The action of optoquin on the pneumococcus and of vuzin on bacillus diphtheriæ is highly specific; the higher and lower homologues have a greatly diminished effect. Many substances destroy bacteria in the test tube, but these drugs act in the animal body as well as in the test tube, and enough can be given by medicinal doses to animals and men to render the blood of these animals bactericidal.

The second group of drugs which exert a marked action on bacteria are certain derivatives of acridine. Trypaflavin was used during the war for infected wounds: unlike most antiseptics it acts better in the presence of protein, but is not sufficiently selective or specific on micro-organisms in the presence of body tissues to be of any real value; it is easily absorbed and readily causes œdema. Rivanol is a more recent derivative of acridine. Morgenroth cured streptococcic infections by injections of rivanol under the skin. The injections to be efficient must be made soon after the infection and in the neighbourhood of the inoculated zone; rivanol will not cure a blood infection. Its discovery is, however, a great advance over any substance previously available in this group, and we can anticipate with some confidence in the near future the introduction of other derivatives which will destroy acute infective agents.

(To be continued.)

THE LAWS OF MOTION OF PARTICLES IN A FLUID.

By Robert G. Lunnon, M.A., M.Sc.

(Abstract of a paper presented for discussion simultaneously to The Institution of Mining Engineers and The Institution of Mining and Metallurgy.)

Recent work on the resistance of a fluid to moving bodies has made it possible to revise the statements of the resistance laws which are sometimes used in the theory of the washing and separating of coal and minerals. Rittinger's Law, for instance, has been widely used in this connection, and though some of its limitations are well known, it would appear to be useful to state them more fully. Very little progress has been made, it is true, with the complex problems which are actually presented by practical processes, but these will never be solved if the difficulties are not first reduced to their simplest form, and then solved correctly in terms of the fundamental properties of fluids. The present note is concerned mainly with an artificially simple problem, and I can only crave the patience of the practical man, whose difficulties may be illuminated by it in the future.

Stream Lines for a Sphere.—I shall first restrict the discussion to single spherical particles. When a liquid or a gas moves very slowly past a sphere, or when a sphere moves slowly through a fluid, the lines of flow are smooth and unbroken, and an exact calculation of the pressure on the sphere is possible. It was first made by Stokes in 1850, and it is the only case in which the full theoretical solution of the pressure has been obtained. When the rate of flow is increased, the space behind the sphere becomes filled with an eddy of definite shape, and the size of this eddy grows steadily with more rapid flow until there flows off from it a succession of vortex-rings. Further increases in speed bring less precision in these rings, and they soon degenerate into a wake of irregular turbulent motion; this occurs, for example,

when a ½-inch sphere is moved in water at a speed of 2ft. per sec. The force on the sphere depends on the width and length of this wake, and grows rapidly at still higher speeds, except that at a very high critical speed the wake suddenly narrows and the force diminishes slightly; this high speed does not at present enter into practical problems.

Laws of Resistance.—It is not surprising that no simple formula can express the relation between the rate of flow and the force on the sphere throughout this complex series of changes. There are formulæ which suit parts of the series : the law of Stokes is exact for its earliest stages, and Newton's Law is a good approximation to its later parts. But the complete reaction can be expressed only by a graph, and the standard graphical relation must always be used if it is desired to know the exact force for any speed. It may be noted that the graph is the same whether the sphere moves through the fluid or the fluid moves past the sphere.

A very important simplification was discovered by the late Lord Rayleigh when he found that a single graph could be used to cover all cases, *i.e.*, for spheres of all sizes and fluids of all densites and viscosities. This standard graph is so valuable that its unfamiliar co-ordinated should not deter the practical man from learning its use. It is in terms of two special coefficients, the Reynolds number, generally denoted by R, and the resistance coefficient, denoted by ψ. The Reynolds number is obtained by multiplying the velocity v by the diameter of the sphere d and the density of the fluid ρ, and dividing by the viscosity of the fluid η. The resistance coefficient is the force on the sphere F divided by the product of the density of the fluid, the square of the velocity, and the square of the diameter. Expressed in symbols this is :

... $R = vd\rho/\eta, \quad \psi = F/\rho v^2 d^2.$

These two quantities are of zero dimensions, that is, their values in any particular case are the same whether the speed, size, etc., are measured in English or in metric units, provided that the same units are used in each term. For instance, if a sphere of coal, ½-in. in diameter and weighing ¼-oz., is placed in a current of water at 5° F. moving at 3-ft per sec., and the viscosity of water at this temperature is 0.00080, in foot-pound-second units, then the value of the Reynolds number is $R = 9{,}760$, and the same number would have been obtained if the quantities had been specified in metric

CANCER AS A WORLD PROBLEM.

Joseph Colt Bloodgood, *Surgical Pathological Laboratory, The Johns Hopkins University, Baltimore, Maryland, U.S.A.*

(From the *Journal of Chemical Education.*)

Chemistry is a fundamental science and most of the problems in chemistry are world problems. Cancer is becoming the chief cause of death in those races in which modern medical science has increased the length of life. The longer one lives to-day the greater is the probability of cancer developing, just as the greater are the chances of accident by automobile.

Chemists will be interested in the fact that at the present moment we need and are searching for a differential stain to distinguish the cancer cell from the abnormal cell that is not cancer and from the normal cell that looks like cancer, but which has been displaced by injury or infection. The Surgical Pathological Laboratory of The John Hopkins University has been enlarged for research through the special gift of Francis P. Garvan, President of the Chemical Foundation, and through a gift of ten thousand dollars a year we are preparing, with the aid of the Color Laboratory in Washington, to test out all stains, both on the frozen section of the fresh tissue from the operating room and on the huge tissue material that has been preserved in this laboratory for forty years. Through the enlightenment of the public, cancer is becoming a microscopic disease. For the best protection of the patient this microscopic disease should be recognised in the operating room by immediate frozen sections. The technic of frozen sections is established. The Terry polychrome methylene blue is an excellent one for frozen sections, but it does not differentiate the cancer cell from the abnormal cell that is not cancer or from the normal cell. Many members of the medical profession are not familiar with this difficulty. The majority of the hospitals of the world are not even properly prepared for frozen-section diagnosis in their operating rooms, but in those communities in which the people are enlightened the surgeons and pathologists in their hospitals are confronted more and more with the difficulties of distinguishing the earliest stage of cancer from pathological lesions that are not cancer. This is the stage that offers most for the cure of cancer. When the little area is situated in the skin or the mucous membrane of the mouth or is a small tumour that can be completely removed, this exact differential diagnosis is of no practical importance, because the entire zone of

however, it is a lump in a woman's breast, the ability to distinguish with certainly in the immediate frozen section the tumour that is cancer from the one that is not, means that the woman who has a lump that is not cancer will not lose her breast. It is even more important when the disease is in the bone, because if the bone disease is cancer (sarcoma type), the entire bone must be resected or the limb amputated. A certain differential diagnosis, therefore, means the saving of the function of the limb if the disease is not cancer. When women are properly informed and are influenced to act at once, and when all married women who have borne children submit to periodic examinations, the number of lesions of the cervix and body of the uterus which come under observation which are not cancer and the number which are in the earlier stage of cancer will be relatively very large, and we need here a differential stain.

It is my opinion that the diagnosis of cancer in the operating room is a world problem and that the search for a differential stain is also a world problem.

Granting that we have educated the people and that periodic examinations are established, that every individual seeks the help of the medical profession the moment he is warned, that the differential stain has been discovered and frozen sections are established in every operating room in the world, the cure of canver will not even then be complete. The probabilities are that cancer of the skin and the mouth will be wiped out. Cancer of the cervix of the uterus may be wiped out. The ultimate cure of cancer of the breast will be increased from ten to seventy per cent. But many cancers are inaccessible at present and we must at least grant that thirty per cent. of cancers recognised early and completely removed will have metastasized. For this reason we must search for the cause of cancer and for its prevention and cure. No one to-day can prophesy which medical science will ultimately control cancer. Many of us believe that chemistry has a far better chance than bacteriology. Some of us are of the opinion that the control of cancer will rest upon an organised attack of all the medical sciences, in which perhaps a new science may develop. At the present moment chemistry is taking its part in the search for a differential stain and the function of the cancer cell, as distinguished from the function of the abnormal cell which is not yet cancer, and the normal cell. Chemistry is interested in the possible chemotherapeutic agent which may ultimately prevent, cure, or control cancer.

HOW SUGAR SOAP IS MADE.

To get a soap powder with a silicate or insoluble mineral filler that is satisfactory to the painter seems almost impossible. These two ingredients leave a film on a cold water-and-brush washed surface, which can only be removed by rubbing cloths, and this practice is too expensive for an ordinary repainting job.

Once, painters used to mix up their own sugar-soap by melting soft soap and soda in a pail by heat, and the manufacturers' formula is based on this operation.

Washing soda	4½ cwt.
Yellow bar soap	28 lb.
Crude palm oil	¾-1½ lb.
Russian or Swedish turps ...	1 pint

For mixing, a steam pan fitted with a stirrer is best. Slice the soap and melt in the pan with two or three pints of water. When the soap is melted, the stirrers are revolved, and the soda is added in portions, just sufficient being shovelled in to keep the whole mass liquid. When all the soda is in, and the mix is liquid, also as cool as possible, the palm oil is added to give colour, then the batch is crutched (or well stirred). Next it is run out on a wooden tray to a depth of about eight inches, where, as it cools slowly, it is stirred. The stirring is done by pegs about 4 inches apart, and reaching to the bottom of the tray or vat, depending from a wooden beam affixed to an upright shaft revolving at the rate of about ten turns a minute. This movement is to ensure that while the soap crystallises slowly, it will not set hard. The sides are kept clear with a shovel, the hardening mass being thrown into the centre, and then, just as the whole lot is about to crystallise, the turps is incorporated by sprinkling it over the whole surface with a toy rose watering-can.

In due time, the beam is raised from the powder and the soap shovelled into bins, where it lies for two days previous to being packed in casks and cartons.

This method may appear crude and simple, but, anyway, it produces the stuff the painters like. Here and there painters use household soap powder, but for a good job, and with a skilled decorator at the back of the job, sugar-soap is unsurpassed.—*The Pharmaceutical Journal.*

COLLEGE OF TECHNOLOGY, MANCHESTER.

The College of Technology offers systematic training in the principles of Science and Art as applied to Mechanical Engineering, Electrical Engineering, and Municipal and

Sanitary Engineering; the Building Trades; the Chemical Industries; the Textile Industries; Mining; and Photography and the Printing Crafts.

A general description of the buildings and laboratories has been given; it is therefore sufficient to state here that the College of Technology possesses extensive laboratories and workshops equipped with full-sized modern machinery, tools, and apparatus, including not only machines of the types now in general use, but also machines especially constructed for demonstration, experiment, and original research.

Candidates entering upon a course for a degree in the Faculty of Technology are required to have passed in Mathematics as a subject of the Matriculation Examination, or to give evidence satisfactory to the Senate of having attained an equivalent standard.

The work of the College includes :—

Advanced study and research in various branches of Science and Technology.

University Courses in the Faculty of Technology extending over three years and leading to Degrees and Certificates in :

Mechanical Engineering.
Electrical Engineering.
Municipal and Sanitary Engineering.
Applied Chemistry :
(a) General Chemical Technology.
(b) Chemistry of Textiles (Bleaching, Dyeing, Printing, and Finishing).
(c) Paper Manufacture.
(d) Metallurgy and Assayng.
(e) Chemical Technology of Brewing.
(f) Electro-Chemistry.
(g) Photography.
(h) Colouring Matters (Higher Course).
(i) Foodstuffs (Higher Course).
(j) Fuels (Higher Course).
Textile Industries.
Mining.
Industrial Administration (one year post-graduate course).

Full-time Courses extending over two years in the Departments of Industrial Administration and Applied Optics and over three years in the Building Department.

Senior Technical and Vocational Courses extending over two years.

Part-time day courses for engineers' and other apprentices whose employers allow them to devote one whole day per week to study;

Part-time evening courses, involving attendance on three evenings a week for five years, which, although they cannot cover the whole ground of the University courses, afford an alternative means of acquiring that training in scientific principles and their application which is required to fit a man, if he possesses the character and personal qualities essential to a Manager, to occupy effectively a position of responsibility in industrial affairs; and

Other part-time classes for advanced study and research, or in preparation for the external degrees of the University of London, or in technological or trade subjects, or in various branches of Natural Science, or in other subjects of which particulars are given in the prospectuses of part-time courses.

CONDITIONS OF ADMISSION.

Persons seeking admission are required :—

(a) To have attained the age of 16 years, or, in the case of women students, 17 years.
(b) To produce a testimonial of good character.
(c) To have passed the Matriculation or other examination required for the course to be taken, or in the event of students not entering for a degree, diploma ,or certificate, to give such evidence of proficiency as may be satisfactory to the Vice-Chancellor and to the Principal.
(d) To sign a declaration that they will observe the Regulations of the University and of the College of Technology.

Students desiring to enter upon a Higher Course of study in the Faculty of Technology for a degree, with the opportunity of graduating with first, second, or third class honours, or with a pass in a Higher Course, are required to have passed the Higher School Certificate Examination, or to give evidence satisfactory to the Senate of having reached the required standard for admission in accordance with the Ordinances and Regulations.

PRE-GLACIAL MAN—RESEARCHES IN EAST ANGLIA.

Some interesting information was submitted by the President of the Prehistorical Society of East Anglia, recently.

The general result of the special excavations made for the Percy Sladen Memorial Trust was, in his opinion, a complete refutation of criticisms, formerly made but now less frequent, based on the alleged abundance of the "rostro-carinate" or beaked type of implements in these East Anglian deposits, and upon the supposed action of

earth movements, glacial thrusts, and pressure of superincumbent material upon the flints. A statistical investigation of the undisturbed " stone bed " showed that rostrocarinates were distinctly scarce, averaging *less than one in 2,000 of the flints in situ in* the bed. Deep excavations showed that the " stone bed," resting directly on the chalk, beneath undisturbed Crag sands, itself contained numerous unbroken shells of so fragile a nature that the slightest disturbance in the beds would have fractured them. In addition, not a single instance was found of the occurrence together of the flint flake and its core. Such would certainly have been found if these flakes had been produced by the pressure of the overlying strata. The technique of the implements discovered, particularly a delicately worked scraper from Thorpe (near Norwich) and a boldly worked hand-axe from Whitlingham, was altogether too evolved for a Pre-Chelles date and showed that the deposition of the " stone bed " occurred in Early Chelles times, much later than the popularly accepted opinion, based entirely on the fauna, considered probable. The recent work emphasised the slight distinction in age between the Crag and the Cromer Forest Beds, in opposition to the prevalent view. It appeared that the complicated sections visible on the Cromer coast could be well explained by comparatively slight oscillations of level causing variations in the deposition of the deltaic and estuarine deposits of the North Sea River and of the contemporaneous marine beds of the Crag. Of 1,100 specimens only 19 per cent. showed heavy striæ, while 48 per cent. were free from scratches, both types occurring in all parts of the stone bed.

Mr. J. G. Marsden described the discovery at Denham, Bucks, of thin pointed ovate palæoliths in a clay deposit at 214ft. O.D., covered by gravels hitherto classed and mapped as glacial by the Geological Survey. Mr. Dewey pointed out that the Denham find was another instance of the occurrence of palæolithic implements in deposits hitherto classed as glacial, and which, in some cases, were inseparable from beds which were continuous with undoubted glacial deposits of the upper levels. Croxley Green and the brick-earth of Gaddeston Row, higher up on the Chilterns, were examples. These need not now occasion surprise, but they were a serious difficulty to those who admitted but one glaciation and regarded man as definitely post-glacial.

ROYAL SOCIETY OF ARTS.

Thirty Years' Experience of Industrial Maladies. By Sir Thomas Morison Legge, C.B.E., M.D., late H.M. Senior Medical Inspector of Factories.

Shaw Lectures.—I. Notification of Industrial Diseases.

(Delivered February, 1929.)

After twenty-seven years' work in the Factory Department and comparison of the conditions then in factory and workshop with those which exist to-day I am amazed with the progress made in the interval. Perhaps it is most noticeable in illumination and locally-applied exhaust ventilation. In the early days I used to see rooms warmed by lighting gas jets and a naked bat's-wing flame on a moveable bracket was the means of illumination to a lathe or loom. When I visited all the white lead works in 1899 in only two of the twenty-three was there a vestige of a primitive form of exhaust ventilation for the removal of dust. So it was, too, in the 860 brass foundries in Birmingham when I visited some of them in 1903 on the quest of those suffering from brass founders' ague. Now every white lead factory is equipped with a system of locally-applied ventilation, and the conditions in brass-casting workshops from somewhat similar provision are vastly better than those I can remember. But more important than that is the spirit of invention in the trades themselves in the discovery of labour-saving devices.

Throughout these lectures I shall lay stress, as a kind of test, on three axioms which experience has led me to enunciate. They are :—(1) Unless and until the employer has done everything the workman can do next to nothing to protect himself. (2) If you can bring an influence to bear external to the workman (*i.e.*, one over which he can exercise no control) you will be successful; and if you can't, or don't, you won't. (3) All industrial lead poisoning is due to the inhalation of dust and fumes; and if you can stop their inhalation you will stop the poisoning. It is not due to dirty hands (*i.e.*, eating with unwashed hands).

Examples of the influences I have in mind are :

(1) Prohibition, *e.g.*, by the substitution of sesqui-sulphide of phosphorus for yellow phosphorus (effected by the Berne Convention).

(2) Conversion of pulp white lead into oil paint ready for the market in automatic closed-in machines without dry grinding.

(3) " Low solubility glaze " in pottery manufacture, by which the same amount of raw carbonate of lead may be used, but so combined in calculated quantity with siliceous material in a " frit " as to be practically insolube in the gastric juice.

(4) Plastic rubber, that is, rubber in which lead oxide has been incorporated in a " mother batch " to the extent of 90 per cent., thus abolishing production of lead dust in later processes (first put into practice by Mr. C. A. Klein, Chemist to the Associated Lead Manufacturers Ltd.).

(5) Disinfection of anthrax-infected wool by formaldehyde—the Duckering process—as carried out in the Government Wool Disinfection Station, (Home Office) Liverpool; and finally, though not quite so successfully,

(6) Locally-applied exhaust ventilation by a fan.

Examples of influences, useful up to a point, but no remedy, which are not external, but depend on the will or whim of the worker to use them, are respirators, gloves, goggles, washing conveniences and waterproof sand-paper.

In the expiring hours of the Rosebery Government, after its defeat, Mr. Asquith, the then Home Secretary, placed the Factory and Workshop Act, 1895, on the Statute Book, section 25 of which called on every medical practitioner attending on or called in to visit a patient whom he believed to be suffering from poisoning by lead, phosphorus or arsenic, or from anthrax contracted in a factory or workshop, to notify it to the chief inspector of factories at the Home Office. A similar duty was imposed on the occupier to report every case to the inspector of factories and to the certifying surgeon. A further sub-section gave power to the Secretary of State to add other diseases to the list as, and when, he thought necessary. In 1901 mercury poisoning was added in consequence of incidents in hatters' furriers' workshops and in the manufacture of thermometers. More recently, in 1917, toxic jaundice from tetrachlorethane and trinitrotoluene (T.N.T.), or any other poisonous substance, was added on account of the mass poisoning from them among aeroplane and munition workers. The reason why a symptom, toxic jaundice, and not poisoning by the substances in question, was asked for I will explain later. Still more recently, in 1920, epitheliomatous ulceration due to tar, pitch, bitumen, mineral oil or paraffin, or any compound, product or residue of any of these substances, and chrome ulceration, were added, and finally, on December 31, 1924, poisoning by carbon bisulphide and aniline and chronic benzol poisoning became notifiable.

Soon after the 1925 Act was passed a medical man was appointed, fortunately, as Chief Inspector of Factories in the person of Dr., now Sir Arthur Whitelegge, K.C.B. I tremble to think what would have happened had the administration of section 25 remained in lay hands. Although I was not appointed the first medical inspector of factories until June, 1898, I can remember the publicity given to the prevalence of lead poisoning in the Potteries and White Lead Works, involving in some cases permanent blindness, convulsions and wrist drop, and to the concealment of cases of " phossy jaw " in the manufacture of lucifer matches. Indeed, it is an ill wind that blows nobody any good, and these terrible facts blew me into the Factory Department, to follow up the cases.

The statistics of notifiable diseases were in a state of chaos. I will let you into the secret of why the detailed figures commence in 1900 and not, as they might be expected to do, in 1896. I discovered that in the Division which included the most important white lead works, the notification by the medical practitioner was treated as one case and the report upon it by the Certifying Surgeon as another, so that the number was doubled. I realised that unless the closely-scrutinised official figures were, like Cæsar's wife, above suspicion, there would be no end to the trouble. Consequently, stringent rules were drawn up for keeping them. No case of lead poisoning was included more than once in each year—second notifications being probably due to relapse or incomplete recovery from the first attack.

In form there is close similarity between this section dealing with industrial diseases and that in the Infectious Diseases (Notification) Act requiring the medical practitioner and the householder to notify the medical officer of health of every case of scarlet fever, diphtheria, etc. It is common knowledge that as regards the householder this enactment has been allowed to become a dead letter or, rather, to be held only as a sword of Damocles over his head, in the presence of flagrant exposure of himself or his child when suffering from infectious disease, because he is thereby credited with medcal knowledge which cannot be expected of him. The case of the occupier of a factory is, perhaps, not quite on all fours with that of the householder because, employing people for his own profit on work in which exposure to poisonous substances is incidental, his duty to take precautions is apparent

and, should injurious effect show themselves, his share in the responsibility for this must, within reason, be brought home to him. A defect in the section to my mind is that notification by the medical practitioner has to be made to a layman. It was a fortunate accident that Sir A. Whitelegge was a medical man. Industrial diseases should be notified to the Senior Medical Inspector of Factories—or Chief Medical Inspector of Factories as he is in everything but the name—who is in the same plane as his informant and can enter into his mind. Fancy the medical practitioner having to notify infectious maladies to the town clerk!

(*To be continued.*)

GENERAL NOTES.

SHIPBUILDING MACHINERY AND ENGINEERING EXHIBITION.

To all those who work in lead, whether in chemical works or domestic plumbing the oxy-acetylene leadburning outfits shown on the stand of Messrs, Allen-Liversidge, Ltd., of Victoria Station House, S.W.1., will be of interest.

The outfit is exceedingly small and can be carried together with the necessary cylinders of oxygen and dissolved acetylene in a neat metal case where necessary. The special blowpipe used produces an exceedingly small hot flame, and although when it was first introduced many lead workers believed that it would not be satisfactory, their fears have been disproved and it is now employed by many of the most expert burners in the country. The small hot flame enables the operator to work extremely rapidly and thereby to avoid loss of heat by conduction.

Leadburning can also be done with a small blowpipe consuming dissolved acetylene and atmospheric air without the use of compressed oxygen. In this case, however, the apparatus is only suitable for flat leadburning, but for this purpose it is most economical and efficient. Oxy-acetylene welding outfits which are used extensively for pipe work by heating and ventilating engineers as well as for constructional and repair work, are also exhibited.

VISIT OF HIS MAJESTY'S TRADE COMMISSISONER AT VANCOUVER.

The Department of Overseas Trade announce that Mr. A. E. Pollard, His Majesty's Trade Commissioner at Vancouver, is now in this country on an official visit.

Mr. Pollard will be in attendance at the offices of the Department during the period September 16 to September 27, when he will be prepared to interview representatives of firms interested in the export of British goods to Canada. He will subsequently visit a number of commercial centres in the Provinces.

Applications for interviews with Mr. Pollard in London should be made at once to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 13812/1/20.

LOW TEMPERATURE ELECTRIC HEATING.

In order to encourage the use in London City offices of low temperature electric heaters, which are said to be more economical as well as more thorough than radiant heat systems, the City of London Electric Lighting Company offers to supply current for the purpose at the reduced rate of ½d. a unit from 7 p.m. to 10 a.m. and at ¾d. a unit for the rest of the day.

Low temperature convectors are stated by the company to secure better results than the radiant type by promoting a constant, though gentle, circulation of air. No part of the convector is allowed to reach a temperature of more than 200 deg. F., and the warmed air discharged into the room is never above 95 deg. The electrical loading of these convectors necessary to maintain an internal temperature of 60 deg. has been found to be less than half that required by luminous radiators in securing the same result. The cost is said to be so small that a convector may be allowed to work all night and so reduce the cost of daytime heating. A room of 1,500 cubic feet can be kept warm between 7 p.m. and 10 a.m. at a cost of 3¾d., and investigations show that by this method the cost of warming can be kept between £2 10s. and £3 per annum per 1,000 cubic feet of room contents.

SURGERY.

CANCER OF THE STOMACH.

According to Lord Berkeley Monyihan, cancer of the stomach is not often cured. It can be removed, and recrudescence prevented, only by surgical treatment. The limits have been reached, for the whole organ has been extirpated, with the lymphatic glands. It is to earlier diagnosis that we must now look. The problem is the same as elsewhere: to discover the earliest signs and symptoms of various diseases.

As with so many other diseases, the symptoms of cancer of the stomach described in the text-books are those of well-established disease, of which eradication is difficult or impossible. Their diversity is striking. In some cases the disease is ushered in abruptly, proceeds rapidly, and within a few weeks is found beyond the reach of surgery. In others triviac symptoms, of a kind experienced before, seem almost to disappear after treatment, to recur weeks or months or even a year later, only then to excite surprise of reluctant suspicion.—*Indian Medical Record.*

DIGESTION.

All food must pass through the many digestive and absorptive processes before it can be transformed into the living material of the body. In the mouth the food is merely mechanically prepared for the stomach except that starchy foods are acted upon by the saliva and partly converted into sugar. But the saliva does not act upon the proteins; these foods are broken up by the teeth so that the gastric juice may act more readily on them. The stomach secretions act upon the proteins but the digestion of starch is delayed by the acid medium of the stomach secretion.

It may not be superfluous to point out that digestion is not absorption. Until the digested contents of the stomach pass into the small intestine, practically no part of the food has been absorbed. It has been prepared for this purpose. Then, when it passes into the intestine it has to be acted upon by three other secretions, the bile from the liver, the pancreatic juice, and the secretion of the intestine, before it is finally reduced to a condition where absorption by the blood and lymph vessels may take place. The residue of the food has to be excreted from the body to complete the digestive process.

The foregoing outline of the physiology of digestion serves to show us that when we are arranging the diet to meet all the demands of a healthy and strong body there are several points which we should keep in mind. First, that the system should be capable of carrying out the functions incident to digestion, such as the muscular movements of the walls of the organs, and that there should be adequate supplies of blood and nervous energy in order that the various secretions are sufficient to attend to the task of digestion. Secondly, the food materials should be of sufficient quantity and quality, and selected to make the process of digestion as normal as possible. Thirdly, the alimentary tract should be kept active and clean so that pathological processes are not allowed to be insidiously established. — *Journal of Ayurveda.*

BRITISH EMIGRANTS AND IMMIGRANTS.

The British subjects who were recorded as leaving permanent residence in the United Kingdom to take up permanent residence in non-European countries numbered 76,370 in the first six months of 1929, as compared with 66,925 in the same period of 1928. Residence for a year or more is treated as permanent residence for the purpose of this classification. Those passengers arriving in the first half of 1929 who were recorded as leaving permanent residence in non-European countries to take up permanent residence in the United Kingdom numbered 29,066, as against 28,851 in the corresponding period of 1928. The number of British emigrants to the British Empire during the first half of 1929 was nearly 7,000 more than in the first six months of 1928; the movement to British North America during the half-year was 43,557, or 14,552 greater than in the first half of 1928, while in the cases of Australia and New Zealand the numbers fell from 15,067 to 8,577 and from 2,258 to 1,785 respectively. No considerable variation is shown in the numbers proceeding to British South Africa, India (including Ceylon), and the group "Other Parts of the British Empire." Comparing the movement of British emigrants to all parts of the Empire during the twelve months ended June, 1929, and June, 1928, an increase of 7,214 is shown for the more recent period. The emigrants of British nationality to the United States numbered 24,762 during the year ended 30 June, 1929, as compared with 22,773 during the year ended 30 June, 1928; the British quota (Great Britain and Northern Ireland only) for each of these periods was 34,007.

CANADIAN MINERAL PRODUCTION.

A report says that Canada, which is the world's fourth most important producer of copper, has every prospect of becoming the third greatest source of this metal within the next ten years.

In order of production values, coal led all other mineral productions with a new high record of 62,881,000 dollars, an increase of 1.3 per cent. over 1927. Gold production totalled 1,891,000 fine ounces, valued at

89,091,000 dollars, an increase of 2.1 per cent in quantity and value.

Taking output by provinces, Ontario produced 83.46 per cent. of the Dominion's gold, British Columbia 10.43 per cent., Quebec 3.17 per cent., the Yukon 1.82 per cent., and Nova Scotia and Manitoba the remainder.

Copper production during 1928 totalled 202,000,000 lb., valued at 28,488,000 dollars, an increase of 44.1 per cent. in quantity and 65.7 per cent. in value.

Nickel production totalled 96,755,000 lb., valued at 22,318,000 dollars, a new high production record, surpassing even wartime production, and an increase of 44.8 per cent. in quantity and 46.2 per cent. in value over 1927.

Production of lead totalled 334,830,000 lb., valued at 15,474,000 dollars, an increase of 7.5 per cent. in quantity and 6.1 per cent. in value.

Silver production totalled 21,922,000 fine ounces, valued at 12,753,000 dollars, a decrease of 3.6 per cent. in quantity and 0.5 per cent. in value.

Production of zinc totalled 186,611,000 lb., valued at 10,250,000 dollars, an increase of 12.8 per cent. in quantity, but a slight decrease in value.

Production of asbestos is valued at 11,238,000 dollars, an increase of 5.8 per cent.

THE INSTITUTE OF METALS.

SYNOPSES OF PAPERS Presented at the Annual Autumn Meeting of the Institute, held in Düsseldorf, September 9-12, 1929.

Aluminium und Seine Legierungen (Aluminium and Its Alloys) (in German). Eighth Autumn Lecture, by DR. A. G. C. GWYER, B.Sc.

The lecture contains a brief account of some of the more important investigations which have been carried out in recent years upon aluminium and aluminium alloys. Attention is directed to the outstanding characteristics of these alloys, and there is given a short account of recent work that has been done to improve the general reliability of aluminium and its alloys, more particularly from the points of view of soundness and resistance to corrosion. The constitution of the more important aluminium alloys, and of aluminium itself, is described. Of recent years the question of the heat treatment of aluminium alloys has received considerable attention. Therefore a considerable proportion of the lecture is devoted to the subject, which includes, of course, reference to the phenomenon of age-hardening. The lecture concludes with a short account of the application of the methods of X-ray spectrography to aluminium—a subject which the lecturer regards as of very great importance, and one which is likely to yield very valuable and practical results in the near future.

Some Methods of Research in Physical Metallurgy. By WALTER ROSENHAIN, D.Sc., F.Inst.Met., F.R.S. (President).

The paper describes the methods which have been developed in recent years, and particularly in the Metallurgy Department of the National Physical Laboratory, for the study of metals, especially in connection with the determination of equilibrium diagrams. The methods of determining and recording thermal curves, resistivity-temperature and dilatation—temperature curves, are discussed in detail, and a brief account is given of a novel form of electrical dilatometer, making use of measurements of the capacity of a small condenser which is varied by the dilatation of the specimen. The measurement of this capacity is made by means of oscillatory circuits utilising thermionic valves, and the resulting graph is plotted by means of an electrical "thread-recorded." Reference is also made to the development of optical pyrometry, and a novel method of securing black body conditions, by sighting upon the interior of a gas bubble blown in a mass of molten metal, is described. The applications of the study of structure by means of the microscope and of crystal lattices by means of the X-ray spectrometer are discussed in regard to their bearing upon the equilibrium diagram. Finally, stress is laid upon the importance of securing accurately known composition and the highest possible degree of purity in the metals and alloys used for investigations of this kind. Reference is made to the methods for producing metals of high purity, and the development of special refractories for that purpose, which have been developed at the National Physical Labatory.

Methods of Research in Metallography. By G. MASING, Dr.-phil.

The fundamental principles underlying the methods of research employed in investigations on the constitution of alloys and in physical metallography are discussed, and it is shown that researches on the constitution of alloys must be based on the well-established thermodynamical laws of hetero-

geneous equilibria. The experimental methods are, however, not sufficient for accurate work and need to be improved in precision and amplified (especially X-ray technique). The most important improvement required is the development of a method for the rapid attainment of equilibrium in an alloy. Besides the establishment of equilibrium diagrams the study of constitution nowadays demands an investigation of the condition of alloys far removed from the state of equilibrium; the theoretical and experimental aspects of this problem are considered.

In physical metallography the greatest interest is evinced in the study of plastic deformation and its attendant phenomena (hardening, recrystallisation, etc.). The importance of using precise physical methods in order to make further advances in this field is emphasised.

A Dilatometric Study of Some Univariant Two-Phase Reactions. By P. CHEVENARD, A. M. PORTEVIN AND X. F. WACHE.

The authors have investigated, by means of a dilatometer, the reactions taking place in quenched aluminium-copper and aluminium-silicon alloys, when annealed at various temperatures.

The laws of precipitation during constant temperature annealing, and the influence of temperature on the speed of precipitation, have been studied.

A hitherto unknown reaction has been found and partially elucidated.

Alloys of iron, nickel, and copper have also been investigated by means of the dilatometer, and the boundary of the two-phase field on the iron side of the system has been determined.

An Improved Differential-Dialtometer. By MAS HAAS, Dr.-Ing., AND DENZO UNO, Dr.-Ing.

The accuracy of Chevenard's optical differential-dilatometer has been improved by mounting the apparatus on a triangular rail, by using one dilatometer tube instead of two, and by replacing the spring that holds the mirror by a magnet coil arrangement. Provision is also made for working in any special atmosphere, and for sketching purposes.

The Open-Air Corrosion of Copper: A Chemical Study of the Surface Patina. By W. H. J. VERNON, D.Sc., Ph.D., F.I.C., AND L. WHITBY, M.Sc., A.I.C.

The patina on copper after prolonged exposure to the open air has been studied, samples having been taken from copper structures in urban, rural and coastal districts respectively. Provided the exposure has been sufficiently prolonged, and in the absence of certain prejudicial circumstances, a pleasing green patina characterises the metal surface in each type of atmosphere. Frequently (in urban districts invariably), the metal passes through a preliminary black stage, the persistence of which is favoured by the presence of lead in the metal and by shielding from wind and rain. In general, the green patina consists essentially of basic copper sulphate. An exception to this is the product from a purely marine atmosphere, in which basic copper chloride predominates; where urban and marine conditions coincide, however, then basic sulphate in the product greatly predominates over basic chloride. Contrary to the general belief, basic copper carbonate enters only to a minor extent into the composition of the product, even in rural districts remote from sea and town. Sulphur compounds, derived from products of combustion and disseminated by wind, are the most potent agents in the development of patina. The underlying metal, after long periods of exposure, shows remarkable freedom from pitting. With the exception of lead, which tends to accumulate in the product, the impurities usually present in the metal have no appreciable effect on the composition or appearance of the patina.

Studies on the Crystallisation of Gold From the Liquid State. By C. O. BANNISTER, M.Eng., A.R.S.M.

This paper deals with the crystallisation of gold from the liquid state, and gives different methods of preventing undercooling "and flashing." It illustrates the formation of straight boundary lines by the interference of radial growth from two, three and four nuclei, and the formation of curved boundary lines by retardation of growth from one centre.

The Creep of 80 : 20 Nickel-Chromium Alloy at High Temperatures. By A. GLYNNE LOBLEY, M.Sc., AND C. L. BETTS, Ph.D.

Wires 0.018 in., 0.0625 in., and 0.25 in. thick were subjected to tensile stresses of 50, 100, 200 and 400 lb./in^2 at temperatures of 700°, 800°, 900° and 1,000° for a period of approximately 4,000 hours, and accurate measurements made daily of the movements.

At the highest temperature there was no evidence of creep stress limit.

The rate of flow was found to be dependent on the diameter of the wire as on the other factors.

The progress of the experiments is given in the form of abridged graphs, and graphs are also used to show the relationship between the various conditions of temperature, stress, and diameter.

The Reduction of Shrinkage Cavities and Vacuum Melting. By W. J. P. ROHN, Dr.Phil.Nat.

Shrinkage cavities may be diminished if care is taken that the solidification of an ingot starts from its bottom end and advances gradually to the top end. This control of the freezing process is not obtainable by using sand-moulds or cast-iron moulds, but can be approximated to a certain extent with water-cooled copper moulds. The special construction of such moulds, to be used in connection with vacuum melting furnaces, is described, and some details given regarding vacuum melting.

Shrinkage cavities, it is shown, may be totally avoided if melting and freezing are performed in an electrically heated melting furnace in a crucible of the shape of a finished ingot, and ,after melting and refining is completed, the current is cut off gradually from the bottom with a well-controlled speed. Illustrations of cross-sections of ingots so produced, and of their crystal structure, are given.

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The County Council invite applications for the post of

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25,471.—Brightman, R., and Imperial Chemical Industries, Ltd. —Azo dyes, etc. August 21.

25,647.—British Celanese, Ltd.—Production of organic compounds containing oxygen. August 22.

25,648.—British Celanese, Ltd.—Production of oxygenated organic compounds. August 22.

25,394.—Carpmael, A. (I. G. Farbenindustria Akt.-Ges).—Manufacture of non-oxamic acids. August 20.

25,237.—Dreyfus, H.—Manufacture of aliphatic compounds. August 19.

Specifications Published.

317,338.—Carpmael, A. (I. G. Farbenindustrie Akt.-es).—Manufacture of azo dyestuffs forming metallic salts.

290,177.—I. G. Farbenindustrie Akt-Ges.—Production of resist effects in dyeing with vat-dyestuffs.

317,304.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges). — Process for the manufacture of nitro compounds of dinaphthylene dioxide and derivatives thereof.

317,419.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges). — Process for the manufacture of azo dyestuffs.

317,572.—Moore, J. W., Lamble, A., and Imperial Chemical Industries, Ltd. —Manufacture of bleaching powder.

Abstract Published.

314,859.—Destructive hydrogenation. — *Bataafsche Petroleum Maatschappij*, 30, Carel van Bylandtlaan, The Hague.

The catalytic material known as "Luxmasse," obtained as a by-product in the purification of bauxite and consisting mainly of alkaline ferric oxide, is subjected to mechanical, physical or chemical treatment, or to a combination of two or more of these treatments, in order to increase its catalytic activity. In the hydrogenation of brown coal in the presence of crude Luxmasse, a residue of 13.0 per cent. remained; with Luxmasse which had been repeatedly extracted with hot water and then dried, the residue was 3.4 per cent.; with Luxmasse which had been dissolved in nitric acid, precipitated with ammonia, washed, and dried, the residue was only 1.8 per cent., all calculated on dry, ash-free coal. It was found that the catalytic activity of the material increased after use in hydrogenation. Specification 309,859 and the French Specification 618,490 are referred to.

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501,161.—A chemical preparation for purifying water. — Ambrose Fry, 1, Cavendish Gardens, Devonshire Road, Liverpool. August 21.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION I.—PHYSIOLOGY.

PHYSIOLOGY THE BASIS OF TREATMENT.

Address on July 24, by PROF. W. E. DIXON, M.A., M.D., F.R.S., President of the Section.

(*Continued from page 165.*)

THE INTERNAL SECRETIONS.

In the last twenty years much evidence has accumulated to show that the glands of internal secretion are responsible for the regulation of growth, of metabolism, and often for our appearance if not for our very character. Exaggeration or diminution in the secretion of one or other of the tissues may induce conditions so decided as to be obvious to everybody, though the effects produced by minor alterations in the co-ordination of the several secretions may not be so evident. Giants and dwarfs, unusual pigmentation and anæmia, disproportion in the growth of the skeleton, such as enlarged hands and face, bulging deer-like eyes or oriental eyes and beards in women are noticeable to everyone; excessive fatness or emaciation, a choleric or bucolic temperament cause no comment, yet may equally arise in the victim from a want of co-ordination in the internal secretion.

The general outlook and significance of drug therapy was led into new channels when it was revealed that the animal body through these glands elaborates its own drugs, stores them generally at the seat of formation, and doles them out to the tissues to meet the needs of the economy. Some of these drugs are of the nature of alkaloid comparable with those elaborated by plants. It is a remarkable fact that when Nature elaborates a drug in either a plant or an animal, that drug is invariably the ideal drug for producing the action for which it is characteristic. No drug relieves pain like morphine or produces local anæsthesia so well as cocaine; no drug paralyses the parasympathetics so perfectly as atropine or the motor nerves so effectively as curarine; strychnine supersedes all other drugs in exaggerating spinal reflexes, and caffeine in its remarkable power of stimulating the psychical centres of the brain. Of the animal drugs, adrenaline has a superlative effect on the sympathetic system, pituitary on the uterus, and thyroxin on general metabolism.

The elaboration of the drugs in nature is on biological lines and the key always fits the lock; it seems as if Nature always says the last word on the particular type of drug she elaborates. Certainly organic chemists have up to now done little to improve on her products.

THE SUPRARENAL GLAND.

The suprarenal gland is composed of two distinct organs. The medulla elaborates an alkaloid named adrenaline, the action of which corresponds with stimulation of the entire sympathetic system. What exactly its functions may be in the animal economy is not certain; its output under normal conditions is so limited that it can hardly affect the blood-pressure and it is not apparently essential for life. There can be little doubt, however, that in moments of excitement adrenaline is liberated in large amounts and that it is responsible for some of the expressions of the emotions. The action of adrenaline under such conditions is to raise the blood-pressure by constricting peripheral vessels, to dilate bronchioles, to erect the hair, to increase the blood-sugar, to immobilise the alimentary canal, and to facilitate the clotting of blood. Cannon has shown than cats respond to psychical stimulation such as may be induced by the presence of a dog, after the entire thoracic sympathetic system has been removed; the interpretation must be that in these emotional conditions adrenaline is set free in relatively large amounts.

The expressions of the emotions, such as anger and terror, are to the animals an advantage; the easy breathing, the ready clotting of the blood, the increased circulation may all have their advantages in a fight. The ultimate cause of spasmodic asthma is constriction of the bronchiolar muscle; if during an asthmatic attack the patient is subjected to some sudden terror or other pronounced emotion the attack sometimes promptly ceases, in a manner exactly simulating the way in which a small injection of adrenaline will abort an attack.

In parts of West Africa the Calabar Bean, Physostigma, was sometimes used, in trial by ordeal, to determine the innocence or guilt of persons accused of witchcraft or other crimes. A normal person after drinking an infusion of this bean promptly vomits and gets rid of the poison. In states of emotion, which might well occur in a guilty person, the stomach is flaccid and immobile, vomiting does not occur and the poison is absorbed. The adrenaline takes some part in this inhibition of vomiting as it stops the

movements of the stomach. The bean ordinarily induces violent contractions of the stomach which cause reflex vomiting.

Ephedrine is an alkaloid which is obtained from a Chinese plant, Ephreda, and which has been used by the Chinese as a medicine from time immemorial. It is closely related to adrenaline and has an action very similar to it; but ephedrine acts when taken by the mouth, whilst adrenaline is so easily oxidised that it is destroyed when administered in this manner; adrenaline causes pulmonary congestion by dilation of the coronaries; ephedrine has no such effect. These are only some of the differences between these two closely related alkaloids.

Ephedrine has proved of great value in the treatment of spasmodic asthma, since oral administration produces prolonged broncho-dilation.

The Parathyroids.

Another striking result from experimental work in the field of internal secretion has recently been obtained in the case of the parathyroid glands. Many vague and unsatisfactory statements existed in the older literature as to the functions of these bodies: but now a potent extract of bovine parathyroid glands accurately standardised can be obtained, and precise knowledge of the part these glands play in the animal economy has become possible. Extracts when injected into a variety of animals raise the level of the blood-calcium; if the injection is made into an animal that has been previously parathyroid-ectomised, tetany and the usual fatal outcome are prevented. Repeated or very large doses in normal animals produce a condition with a definite clinical and biochemical picture—a condition of "hyper-calcæmia," in which the blood-calcium may rise to very high levels and in which a characteristic train of symptoms is found with terminal renal failure. Many secondary changes occur, of course, in the blood chemistry, but a closely similar if not identical syndrome is produced by the simultaneous injection of large amounts of $CaCl_2$ and NaH_2PO_4.

All this work has shown beyond doubt that the parathyroid glands produce a substance which is responsible for controlling the level of blood-calcium, and that interference with this function by removal or disease of the glands can be overcome by treatment with the potent extracts now available. How this substance, manufactured by the glands, produces this effect has not been completely elucidated. Much evidence suggests that the rise in blood-calcium is independent of any change in absorption from the gut or in the rate of excretion: Greenwald in prolonged experiments on dogs, and Hunter and Aub in men, obtained indirect evidence to suggest that the rise in blood-calcium and consequent increased excretion after the injection of parathyroid hormone was due to mobilisation of the element from the bone reserves.

Interstitial Hormone.

A third active substance distinct from oestrin and corpus luteum is elaborated from the ovary and was described by Marshall and myself. This substance is water-soluble and thermo-stabile, and can be prepared from the ovary at one stage of its cycle only, by maceration with warm saline followed by boiling and filtering. The injection of this substance into animals causes a secretion of pituitrin, and this in turn renders the uterus supersensitive and highly responsive to other forms of stimulation.

The pituitary secretion passes either entirely or mainly into the cerebro-spinal fluid. Histological examination has shown that the gland is suspended in a bath of cerebro-spinal fluid and has an opening, at least in some animals, directly communicating with this fluid. Since the experiments of Marshall and myself this secretion of pituitary into the cerebro-spinal fluid has been confirmed many times, more particularly by Trendelenburg, Janassy and Horvath, Miura and Siegert. The reason some investigators have failed to find pituitrin in the cerebro-spinal fluid is because they have tapped the theca too low in the spinal axis. Pituitrin after excretion is rapidly absorbed and never reaches beyond the cervical cord. It has been suggested that the secretion of oxytoxic substance is not really pituitrin, but some other substance, and to this it can only be replied that it exerts every known chemical and physiological action of posterior lobe extracts. In my Dohme Lectures I gave the last piece of evidence in this respect by showing that it also exerts the melanophore dilator action on the frog, an effect which, so far as I know, is quite specific. Trendelenburg has also described this action.

The pituitary gland is intimately connected with the phenomenon of pregnancy; statistics show that the size and weight of the gland in men and nulliparæ are about the same; in primiparæ the weight has increased by about 50 per cent. and in multiparæ by about 90 per cent., although most of the increased weight is due to the anterior lobe.

The posterior pituitary substance has at least three actions of importance in medicine : it inhibits the secretion of urine, it has an antagonistic action to the insulin effect, and it sensitises and, in larger doses, contracts the plain muscle of the uterus. The last action is so profound that it overshadows all the other muscular effects, and pituitrin may be said to have a true specific action on uterine muscle in rendering it supersensitive to every form of extraneous stimulus.

Our experiments showed that at one stage only of the ovarian cycle was this hormone degenerating. So long as the corpora are functioning they control the metabolism of the ovary, but when they degenerate control is lost and the ovary liberates the specific substance which excites the pituitary gland to secrete. This means that extracts of the ovary made between the heat periods or during pregnancy are without effect on the pituitary gland, but extracts made just before the heat period or just before parturition induce secretion of the gland. As the significant action of pituitary extract is to sensitise the uterus it is difficult, if not impossible, to avoid the conclusion that these two phenomena are closely associated.

It is well known that substances introduced into the cerebro-spinal fluid find their way almost immediately into the blood, and hence it might be expected that extracts made from the blood of pregnant rabbits obtained at the time of delivery would have a contractile influence on the uterus; this has been found to occur. Similarly blood obtained from pregnant women at the time of delivery contracts the guinea-pig's uterus to a considerably greater degree than normal blood. Mayer collected the cerebro-spinal fluid from women during Cæsarean section. This fluid he injected subsequently into ten women with deficient labour pains. In eight of the women pains were induced, which in four were followed by the birth of the child. In another case an intradural injection was made, which was followed by labour pains within twenty-four hours. Mayer states that the cerebro-spinal fluid contains the active principle of the pituitary responsible for the production of uterine contraction. Siegert found that pituitrin, which is normally present in the cerebro-spinal fluid, diminished in the later months of gestation.

The interaction of bile salts and pituitary secretion is antagonistic on the uterus. Hofbauer shows that there is a steady increase in the bile salts in the blood of pregnant women as gestation proceeds. He thinks that this factor is responsible for the control of the pituitary secretion during pregnancy, and that toward the end of labour the pituitrin action overshadows the bile-salt action so that labour occurs.

All these experiments consistently support the view that in the presence of fully formed corpora lutea the normal ovarian secretion is held in abeyance, and this is the condition for a short part of the time between the heat periods, but more particularly during pregnancy. At the close of pregnancy, when the corpora lutea are in an advanced stage of involution, the normal secretory activity recurs and the pituitary gland is excited to secrete more actively. When the threshold stimulus of the pituitrin on the uterus is reached the pains of labour set in and parturition results. The well-known phenomenon of the growing irritability of the uterus in the later stages of pregnancy, which is the typical effect of the pituitary action, is explained as being functionally correlated with the involution of the corpus luteum.

It is not suggested that the ovario-pituitary endocrine mechanism is the sole factor in producing labour pains. No doubt the fœtus itself acts as a direct stimulus, and without the fœtus the intense muscular contractions would not occur, but it is also clear that the onset of labour cannot easily be accounted for without postulating some further exciting cause apart from the fœtus and the uterus.

In conclusion, no romance can be more remarkable than the fact that doctors, by using pituitary extract to stimulate the uterus in pregnancy, should have adopted the method which Nature herself employs and that physiological function is after all a pharmacological action.

CONCLUDING REMARKS.

Civilisation has been responsible for many new diseases. Our foodstuffs in great cities are often preserved and important constituents of fresh foods may be lacking. The science of dietetics has assumed an enhanced importance lately, which is partly due to the artificial preparation of our many of our foods. Many experiments have been made in my laboratory to show that certain foods given in excess to animals fed on a synthetic diet, but containing an ample supply of the recognised vitamins, suffer from poisoning sometimes of the most profound and fatal kind. The same experiments made on animals living on an ordinary diet show that the excess of the "poisonous" food is harmless. For example, certain

preparations of irradiated ergosterol given to rats which are being fed on a synthetic diet act as a poison, but if the rats are fed on bread and milk the effect of the ergosterol is negligible. In real life we do not live on a completely synthetic diet; nearly everyone takes some if not an abundance of fresh food, so the practical value of this type of experiment may be over-estimated, though it is of considerable academical interest.

Civilisation has brought bad sanitation in houses, and even our windows may be depriving us of fresh air and filtering out certain rays of light, bringing its attendant tuberculosis—for tuberculosis is a disease of houses. Science is now engaged in endeavouring to remedy the evil effects which it has produced.

Civilisation is associated with wealth, indoor life, luxury, and sometimes excessive mental exercise. These are conditions which lead to exaggerated nervous sensibility, and this is a much commoner feature in those engaged in a mental indoor life than in those engaged in an outdoor physical life. It is not difficult then to understand the excessive use of tobacco in some of these people, since one effect of tobacco—and perhaps its most beneficent effect—is to increase the threshold of sensation in those who are supersensitive. When this supersensitiveness reaches extreme limits these people are referred to as "neurotic." They are so highly reflex, so easily responsive to external impressions, that the associations set loose by any ordinary stimulus cause such a complexity of cerebration that the ordinary affairs of life become a burden; they are not phlegmatic and uninteresting, but are often possessed of quick perception, a rapid response, and other higher attributes of mind which go to make up high breeding and culture. They easily weary of the strain and anxiety involved in the fight for existence, and anything that gives relief from their cares and anxieties is seized with avidity. Now it is these higher faculties of mind which are most responsive to narcotic poisons, which influence these long before those concerned with movement and ordinary sensation — so that the supersensitive people under the influence of narcotics lose the exaggerated effect of their sensations, and become more like normal people; the everyday trifles and inconveniences of life are no longer exaggerated out of proportion to their significance, and life, instead of being oppressive and anxious, becomes pleasant and free from worry. Perhaps in a few special instances persons possessed of such vivid sensations may benefit by a narcotic which limits these conflicting impulses by allowing a free play of some of the higher mental faculties; certainly the records of De Quincey and Coleridge suggest such a possibility. Hence it is easy to understand the modern tendency in some highly civilised nations to indulge in narcotic drugs like morphine, heroine, and cocaine.

It is another curious fact that it is just these supersensitive people who drink the caffeine beverages, like tea and coffee, in excess. Since the seventeenth century the use of the caffeine beverages has slowly increased, whilst that of beer and allied drinks has slowly diminished. Beer, from its essential oils and alcohol, is a soothing beverage; it depresses the higher faculties of mind, it does not exaggerate their activity. Caffeine, on the other hand, relieves drowsiness and fatigue by direct stimulation of the brain cells; it facilitates sensory impressions and the association of ideas. In large dose the caffeine beverages induce restlessness and nervous excitability, and they may produce disturbed sleep, headache and confusion. Few people, no doubt, take caffeine to this extent, but most of us take from 2 to 5 grains of caffeine daily, and the effect of this continued as a daily ration throughout life is a factor the significance of which is unknown. We do know, however, that caffeine increases sensitiveness to ordinary physical as well as mental sensations.

England was once a drunken nation, and the larger towns contained such notices as, "Here you may get drunk for a penny; dead drunk with clean straw for twopence." Before the revolution the consumption of beer alone in England and Wales was 90 gallons a head per annum; now it is about a quarter of this. With this diminution of beer drinking is associated a truly enormous increase in tea and coffee drinking. To me it seems no unlikely that this substitution of tea for beer is not wholly unconnected with the tendency of highly civilised nations to become supersensitive and neurotic, for this is the groundwork upon which drug addiction is built.

I have endeavoured to show that all precise knowledge in therapeutics is based upon controlled experiments on animals or man, and that the elucidation of the action of medicaments by the methods and data of experimental physiology is one of the most important steps taken to place medicine on a scientific basis. How important this is may be gauged from the fact that all fundamental advances in treatment in the last

thirty years have originated directly or indirectly from experiments on animals.

There can be no doubt then that the future of therapeutics, and therefore of medicine as a whole, is intimately connected with physiology; there can be no donbt that advance in the practice of medicine is dependent on those trained in the methods and fundamental truths of physiology, who devote themselves in the ward and biological laboratory to investigating how best to prevent or cure disease and so relieve suffering.

Britain for fifty years has every reason to be proud of her progress and achievements in physiology; it is acknowledged that she can show records second to none and that her savants have included some of the world's greatest investigators. It remains for us to hope that in the future she may attain equal success in the associated sciences directly concerned with the relief of suffering and cure of disease.

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The primary object in preparing the catalogue has been to assist those engaged in the mining industry in dealing with the problem of danger from accumulations of water and the other problems that may arise from the existence of old workings in proximity to present-day workings. But the catalogue may be of service also to persons interested in mineral prospecting and development and to others who, for various reasons, may be interested in the question of surface subsidence in particular localities.

THE BIRTH OF ENERGY AND SOME UNTHINKABLES.

By F. H. LORING.

In this Journal of August 30, 1929, *139*, 130, I discussed some ideas which are contrary to accepted opinion; the title of the article being: Notes on Atomic Energy and Radiation. In particular that the internal heat of stars arises from the converse of a random state of affairs, and therefore the second law of thermodynamics is in a sense violated.

This calls for some further explanation. The principle of the conservation of energy is universally accepted, and for anyone seriously to doubt its validity would seem to be courting disaster. If the ordered state of affairs exists in stars,* where does the energy come from, seeing that, according to the doctrine of the conservation of energy, the mere 'ordering' would not in itself supply the requisite energy. My views are therefore either contradictory, or they lead to difficulties; but, are not the assumptions of *the conservation of energy* and the absolute validity of *the second law of thermodynamics* carried too far in this case? Are there not *limitations* in these two laws?

In order to make these queries serious considerations, surely we must go deeper. We cannot conceive a remote time when there were no stars, or their equivalent; nor can we imagine a time when there was no energy at all; yet a beginning from zero, so to speak, suggests itself to the mathematical mind. We are certainly very little advanced in these far-reaching matters. We can conceive, perhaps, that what we call energy has some origin. If it can be made to originate when a super-order exists in the interior of stars, then the above laws have limitations in the larger and deeper scheme of the universe.

The argument can be more precisely developed as follows:—*The principle of the conservation of energy*—throughout the universe, if the principle is extended, as seems fundamentally necessary — involves energy having come into existence *instantaneously, en bloc*, not being born by degrees. It implies also that there was an act that occurred at one inconceivably remote period in time, and that the birth of energy does not occur continuously by degrees extending to the present time and beyond, indefinitely.

As these beginnings of things are unthinkable, so, too, the principle of the conservation of energy *in the above fundamental*

* See article cited above.

sense is also unthinkable. In our limited and superficial world it is a true enough observation. Is it true in the case of the stars?

Energy may be born in the stars. *Born out of what?* is the question to be asked. *That matter there is dissolving into radiation*, is the answer many of the present-day astronomers would give.† Matter, however, involves in itself energy, as in the example to follow, so that the process becomes a transformation, or a change of form, of energy. *This, therefore, leads back to the en bloc instantaneous creation of the whole energy of the universe, which is unthinkable.*

When an electron falls to a position nearer to the atomic nucleus, radiation is given out, and if Einstein's energy equation is of universal application this act must give rise to a loss of mass—too minute to be measured of course, but nevertheless a mathematically expressible quantity. Furthermore, if the electron falls *into* the nucleus, the nucleus taken as that of the hydrogen atom, its mass dissolves completely into radiation; but, in this case of the disappearing mass, it is enormously greater than in the case of the ordinary radiation process just mentioned.

A question arises here, Are we to assume that Einstein's energy equation does not apply to the atom giving out ordinary raiation, but that it *does* apply to stars where there is supposed to be a large dissolution of mass as indicated by their output of radiation; or, are we to say that energy is *created* in the stars and that the second law of thermodynamics is not then applicable?

If the argument reduces to, or involves of necessity, *the unthinkables*, as given above in the case of energy, then the answer is indefinite, and one is justified in considering other features which are contrary to current opinion, as I have discussed in an article in the *Chemical News* referred to at the outset.

To talk about the birth of energy may seem strange, just because it is not to us a common everyday experience. Many things which we are familiar with do not seem strange, but they would be exceedingly strange if we encountered them for the first time without any relevant preparatory knowledge, as Jeans points out in his little book ATOMICITY AND QUANTA (1926). All fundamental matters are strange in science because we know so little about them.

† The evidence that such is the case is not directly experimental.

There seems to be an enormous waste of energy in the universe—the radiation from stars for example. Is there a corresponding birth of energy? This would make the conservation of energy a disconnected phenomenon which has support from the quantum theory.

It is just here that we get a form of discontinuity that is of great potential interest. It is certainly something in my opinion worth pondering over. Like gravity, the space-gap of discontinuity is the real mystery. To fathom that, takes us beyond the depths of all that is thinkable into the realm of the unthinkables. Can the mind ever grapple with such problems? *Mathematically* the answer is *yes.*

Then again we have the question of chaos *versus* order. Did the universe arise out of chaos, and is it now becoming more orderly; or, was the first state one of order and from thence onward is complete or partial chaos the ultimate goal? For the present they must be labelled the *unthinkables*, but about which we may give thought. At any rate, the answer seems bound up with the discontinuity principle just discussed, but the gaps therein are still unthinkable. How can an event occur at one place and then another event occur at another place of exactly the same energy value without some interconnecting mechanism? Stated another way, energy is born and dies of dissipation while the same quantity of energy appears as if born at another place. A reserve of energy seems to be tapped in order to maintain a balance in the world's account. The star's account, according to the suggestion above, seems to be balanced by a state of order within its own system. Looking at it from the point of view of national finance, the gold reserve in the star is not real gold, but something that is put into a state of order, just as a trained and ordered army becomes a reserve for power which would be lost if the soldiers remained scattered. All this is, however, quite unthinkable when it comes to working it out, as the ideas do not make connection with our experimental knowledge. Perhaps, however, we should not attempt to force a connection, but let matters continue to drift apart until some master mind comes along and clears the way for a deeper understanding.

STUDIES ON THE CRYSTALLISATION OF GOLD FROM THE LIQUID STATE.

(A paper delivered at the Dusseldorf meeting of the Institute of Metals, September 9.)

By C. O. Bannister, M.Eng.A.R.S.M.

Synopsis.

This paper deals with the crystallization of gold from the liquid state, and gives different methods of preventing undercooling and "flashing." It illustrates the formation of straight boundary lines by the interference of radial growth from two, three, and four nuclei, and the formation of curved boundary lines by retardation of growth from one centre.

In a paper on "A Simple Method for the Detection of the Platinum Metals in Cupellation Beads," photomichographs were given of the surface structure of gold beads showing the results of solidification of metal round nuclei at approximately equal rates in all directions, and crystal boundaries formed by the mutual interference of growth from different nuclei. As such methods of crystallization are seldom mentioned by authors, and never illustrated by actual photomicrographs of solidified metals, the examination of the method of crystallization of gold beads has been continued, and some of the results are given below.

Crystallisation has generally been described as proceeding from nuclei by the formation of skeleton crystals, which develop almost exclusively in the direction of certain axes from the different nuclei, giving rise to elongated and much-branched forms of skeleton crystals. The process of crystallization from such nuclei must ultimately reach a limit, owing to the interference of adjoining crystallites when the growth of the axes is arrested, and further solidification of metal takes place interaxially until the spaces are filled up with solid matter, resulting finally in the formation of a more or less irregular polygonal structure.

C. Benedicks, in his discussion of a paper by C. H. Desch, on the "Solidification of Metals from the Liquid State," dealt with the formation of the primary cell structure of a metal just solidified from definite nuclei distributed at random. He took as the simplest case, crystallization speed the same in all directions, which results in the formation of spheres, and showed that the crystal boundaries were formed in the solidifying metal by interference of growth from different nuclei, the boundary lines in each case being the loci of points equidistant from the nuclei concerned. N. T. Belaiew has carried this idea further, and has shown that the shape of the crystalline grains formed depends on the relative distances of nuclei and rates of linear crystallizing velocities. He gives diagrams illustrating crystallization from six nuclei distributed round a seventh, and shows that from equally distributed nuclei, with equal velocities, the boundaries between the central grain and the six neighbouring grains form a regular hexagon, and that from evenly distributed nuclei when velocities are not equal, and from unequally distributed nuclei with equal or unequal velocities, the results are irregular hexagons.

That solidification may proceed from centres with an approximately equal linear velocity in all directions is shown.

A large number of experiments have been carried out to determine the best conditions for obtaining radial crystallisation from centres, and it has been found that minute traces of platinum metals having melting points higher than that of gold, such as platinum, irridium and ruthenium, considerably increase the tendency for the formation of the circular strata, and that even a minute trace of cupel matter has the same effect. The presence of such materials eliminates the tendency for undercooling to take place, and practically stops the well-known "flashing" phenomenon observed when pure gold solidifies, and the same result is obtained by touching the solidifying metal with a gold wire. Gentle movement of the vessel on which the molten gold rests also prevents the undercooling and "flashing" of the metal, and in this case also radial struture of solidification results. By pouring molten metal on to a warm porcelain plate a crystalline surface showing radial formation of crystals is also obtained.

It is certain that the method of solidification—that is, with or without "flashing"—alters the nature of the crystalline surface, for when "flashing" occurs the crystalline surface shows an irregular polygonal structure, without any indication of radiating solidification. Sir T. Kirke Rose, in the discussion of the first-mentioned paper, considered that the structures there shown were obtained from beads which had not "flashed," and that any button which had "flashed" showed a very minute frosted appearance.

It appears from the above that, when conditions are such that solidification proceeds

without "flashing" of the bead, it occurs within the metastable range of Ostwald, whereas, when "flashing" occurs, solidification does not occur until a lower temperature is reached and the metal is in the labile range. Under these latter conditions there is certainly a tendency for the crystalline structures to be smaller.

PAPER AND CELLULOSE PRODUCTION IN CZECHOSLOVAKIA.

Last year was favourable for the Czechoslovak paper industry. In spite of the increased capacity of the various works, they were fully occupied. The consumption in the country itself rose considerably; exports declined slightly whilst imports showed a small increase. The production of and trade in cellulose developed as follows during the year under review:

	1927	1928
	Tons.	
Production	200,000	242,000
Imports	4,332	5,430
Exports	92,361	93,422

According to these figures, the home consumption of cellulose has increased from 111,971 tons in 1927 to 154,008 tons in 1928. The following table shows the figures for the paper industry:

	1927	1928
	Tons.	
Production	220,000	234,000
Imports	3,640	5,236
Exports	50,880	50,520

ORE DRESSING AND METALLURGY.

The Canadian Department of Mines has just issued a collection of investigations in ore dressing and metallurgy. During 1927 the experimental and research work on the treatment of ores increased fifty per cent. over that of 1926 and since then has made heavy demands upon the Department which serves the mining public. The ores examined were gold, silver, lead and other metallic ores and certain other minerals. There are also reports from the Non-Metallic and Hydrometallurgical Laboratories, and it is to be inferred that there is great activity in Canadian mining enterprises.

The prospectus and announcements concerning day and evening classes in chemistry, physics and engineering at Northampton Polytechnic are now available. The prospectus gives a full account of the course of studies carried on at this important technical institution.

ROYAL SOCIETY OF ARTS.

Thirty Years' Experience of Industrial Maladies. By SIR THOMAS MORISON LEGGE, C.B.E., M.D., late H.M. Senior Medical Inspector of Factories.

SHAW LECTURES.—I. NOTIFICATION OF INDUSTRIAL DISEASES.

(Delivered February, 1929.)

(Continued from page 170.)

Are there any other forms of poisoning or any other industrial diseases which should be added to the list? The object of notification is not primarily to obtain statistics in the same way as devolves upon the Registrar General, but to obtain a clue to conditions over which the inspector can exercise control. Publicity, too, from the requirement to report cases is a salutary means of effecting, often enough, improvements in working conditions. I cannot say what strange new potent agents the chemical industries have in store for us, but at the moment I should say there would be advantage in including in the list chronic poisoning from hydrogen sulphide gas and dermatitis due to dust and liquids, expensive though the latter would prove to be.

Notification of industrial disease is more difficult than is notification of infectious disease. One difficulty the medical man is faced with is that, with the exception of anthrax, the poisonings he is expected to notify do not present the same unequivocal signs that acute infectious diseases like smallpox or scarlet fever do. No absolute definition of what constitutes industrial poisoning is possible, and each practitioner in reporting what he "believes" is one, must form his own standard in the same way as he forms his own standard of what constitutes ptomaine poisoning or fish poisoning. The point is that, owing to the slow onset of these insidious, industrial maladies, the patient passes through a stage of absorption which does not amount to poisoning and yet in which the stigmata of the particular compound—the blue lines on the gums from lead, the tremor from mercury, the cyanosis from aniline—are apparent. The medical practitioner has, therefore, in the first place, to make a differential diagnosis between the symptoms in lead poisoning, let us say, and the commonest everyday ailments — headache, anæmia, stomach-ache, rheumatism; and, secondly, he has to make up his mind whether absorption is so advanced as to have exploded in acute or chronic poisoning. Common sense, however, dictates the desirability of fixing

in some way the degree of severity of symptoms which should lead to notification, and few medical men probably would deny that, *generally speaking, any symptoms necessitating absence from work and appeal to a doctor for treatment constitute sufficient* grounds for notification.

With *mercury poisoning*, as it occurs from inhalation of the fumes given off in the manufacture of clinical thermometers, and from the gradual absorption of the metal through the skin of the workman's hands, on which tiny droplets can be seen through a magnifiying class, for one case notified you will find in the shop perhaps twenty showing slight tremor, hesitation in speech, a flabby, indented tongue, coated teeth, slightly spongy gums and salivation pointing to absorption all the *time of infinitesimal* quantities of mercury. If you come up behind them and surprise the worker by a tap on the shoulder he will start as though he mistook you for a policeman—an indication of mercurial erythism. Similarly is it with the hatters' furriers, who inhale the floating particles of rabbits' fur which has been "carotted," *i.e.*, brushed with a solution of nitrate of mercury and thus becomes the vehicle for conveying the metal. Mercury poisoning, however, affords a magnificent example of *invention—discovery of* methods external *to the workman removing the* danger. The account we read of in Bernardino Ramazzini's book of the Diseases of Tradesmen, published in 1703, of mercurial poisoning in the Middle Ages shows it to have claimed far more victims than it does to-day. And why? Because the goldsmiths and silversmiths used an amalgam of mercury with gold and silver—watergilding—to decorate the ornaments they made and, to leave the precious metals behind, the mercury was volatilised by heat over a fire with evolution of toxic fumes. Mirrors, similarly, were backed with the same amalgam with terrible results to those who practised it in Fürth in Germany.

Arsenic poisoning, although apparently so trivial in numbers, is industrially as interesting as is the criminal administration of its salts, although for quite other reasons. And the symptoms bear little resemblance to one another. Arsenical poisoning industrially occurs in two quite distinct forms: (1) from inhalation of, or contact with, the dust of salts of arsenic, showing itself in skin eruptions, especially where the dust, say, of emerald green or sheep dip "flies" and alights on folds of the skin, or on moist surfaces like the groin; and (2) from inhalation of arseniuretted hydrogen gas, showing itself most dramatically in the development of a coppery jaundice and hæmaturia owing to the fact that the gas is the most powerful destroyer of the red blood cells.

Phosphorus poisoning, the horrible redoubtable "phossy jaw," is now only of historical interest, since practically all the civilised countries (commencing with Denmark) have bound themselves to observe *the terms of the Berne Convention of 1906 prohibiting the use of white phosphorus in* the manufacture of lucifer matches.

Of all industrial maladies, *anthrax*, ridiculously small in the number of cases and deaths, when compared with measles, for example, holds out the greatest terror for the workman in those branches of industry in which it is prone to occur. It always makes a frontal attack and is, in this respect, a splendid antagonist, so different from lead poisoning and fibroid phthisis—slinking and slow diseases, taking years to revelop and incapacitate. For anthrax a fortnight is time enough for either a cure or a kill. And anthrax is no respecter of persons; the very strong and robust succumb as readily as, if not more readily than, the weak. I have had many strange experiences with anthrax, and if I were superstitious, and had lived in the Middle Ages, I should have burnt many a candle at the altar of St. Blaise, the patron saint of the woolcombers, as shown in a stained glass window in Oxford Cathedral, to protect me from the demon of anthrax. The disease is due to a bacillus which attacks hoofed animals—horses, goats, cattle, sheep and pigs—but not fur yielding animals, and from the fleece or hides of animals which have died of the disease in any part of the world—and in many parts it is far more prevalent than in this country—it may be conveyed to man. The blood of an animal dead of anthrax teems with bacilli which, as soon as they some into contact with the oxygen of the air, become converted into spores indestructible except by steam, boiling water or certain chemicals. Dr. J. H. Bell, of Bradford, was the first, in 1878, to prove the identity of the disease in animals and man. Anthrax is a world-wide question. Only two ways of mastering it are possible. One is to prevent animals contracting the disease by the use of Pasteur's method of vaccination. Could this but be done it would be splendid, because it would protect both animals and men, but who imagines that inocculation of the herds of sheep and goats in Asia Minor, Persia, India, Thibet, or of the horses in Manchuria, or the cattle and

buffaloes in Africa and the Straits Settlements and China, or the Alpaca sheep in Peru, is practicable?

The other way is disinfection of particularly dangerous classes of wool.

Toxic jaundice, with its sudden rise and equally remarkable fall and attendant high case mortality of about 33 per cent., is very remarkable. The fall is due to the fact that the *extraordinary* use of T.N.T. ceased after the war. But even if it had continued we should have been able to watch it with complacency, as its mode of entry into the system had been discovered and means, external largely to the worker, found to combat it by mechanical methods of filling shells. In 1903 Dr. Prosser White of Wigan and Dr. John Hay of Manchester, experimenting on themselves, showed how rapidly dinitrobenzol passed through the skin into the blood. In the early stages of the war this marked effect of the nitro and amido derivatives of benzene were rather lost sight of.

Of *Epitheliomatous ulceration* (skin cancer) and *chrome ulceration* I will speak together, to bring out the striking difference between them. Both were made notifiable in 1920, and the figures in both stand rather high. But why in the case of chrome is there not a single death and why in that of epitheliomatous ulceration is the death rate so high (some 33 per cent.)? That is because coal tar and mineral oil and certain of their derivatives exert a carcinogenic effect on the epithelial cells and chrome does not. No complete influence external to the workman can stop chrome ulceration, but watchfulness and first-aid treatment will alleviate and hold it in check. Skin cancer on the other hand will be got rid of in the course of years to come by either the elimination in the tar and mineral oil of the not-yet-discovered carcinogenic substances, of by their neutralisation or destruction.

Aniline poisoning, as has been said, is intended to cover poisoning from any nitro and amido derivative which penetrates the skin directly by dissolving out the natural grease and combining with the hæmoglobin to form methæmoglobin. The cases notified are but samples of several others in which the ashen grey colouration of the lips and tips of the ears is present without the worker being aware that anything is peculiar about his complexion. A drop of his blood, however, when the lobe of his ear is pricked with a needle is chocolate coloured. Truly the blood can stand a great deal! Hot summer days prove too much for it, and I have known factories manufacturing these compounds idle because all the men were ill. If work has to be done at all in the summer it must be done before the sun is up or after it is down.

Carbon bisulphide only became notifiable in 1920. It is an interesting instance of a poison the toxicity of which was notorious forty years, and then was satisfactorily dealt with by regulations.

GENERAL NOTES.

IGNITION OF FIREDAMP.

When dealing with a matter which is the subject of constant research, both in this and other coal-producing countries, it becomes essential that the results of earlier work be reviewed from time to time in the light of new data and the old interpretations confirmed or revised.

"The Ignition of Firedamp" is a subject of this nature and in the Paper under that title just issued by the Safety in Mines Research Board (S.M.R.B. Paper No. 53, H.M. Stationery Office, price 6d. net) the information given in Caper No. 8. of 1925, has been revised and supplemented.

The Paper summarises present knowledge as to the conditions under which various forms of heat application (compression, contact with flames, electric discharge, friction, etc.) reach the combined intensity and duration necessary to cause ignition of the various inflammable mixtures of firedamp and air.

GUIDE TO CURRENT OFFICIAL STATISTICS.

The complexity of modern civilisation demands, alike from the expert and from the layman, an increasing knowledge of the organised activities of the community and the social phenomena to which they are related. Recognition of the extreme importance of statistics, as the most convenient means of acquiring this knowledge, has proceeded apace in recent years; but it may often happen that the enquirer has, in the first instance, to discover for himself where the desired information can be obtained.

So far as official statistics are concerned (and, as regards both scope and authority, Government publications form the most important source of statistical material in the United Kingdom) this requirement is met by the "Guide to Current Official Statistics." This extremely compact publication, a fresh volume of which is issued every year,

not only gives a list, arranged under Departments, of volumes containing statistical information, but also provides a detailed index of subjects, in which are indicated the exact characteristics, as regards date and place, of the statistics to which reference is made. Special devices are employed to facilitate the use of this index by even the most casual enquirer, and to enable the appropriate reference to published official statistics on any subject to be readily traced.

BRITISH COLUMBIA'S MINERAL OUTPUT.

The Semi-Annual Bulletin of the British Columbia Department of Mines estimated that the mineral output in the Province during the first six months of this year reaches a total value of $35,256,063, an advance of 7.8 per cent. over the figure for the first half of 1928. Should the production for the entire twelve months continue at the same rate, the output value would total in the neighbourhood of $70,000,000, thus breaking all previous records for the twelve months.

A new record may also be attained by 1929 in the matter of dividends paid by the mining companies, a total of about $12,000,000 being expected.

WOOL RESEARCH IN CANADA.

The National Research Council of Canada at Ottawa has set up in conjunction with the Dominion Department of Agriculture and the Universities of Saskatchewan and Alberta, a new Wool Research Laboratory, which will undertake four projects, the object of which will be to secure an improvement in Canadian mutton and wool by developing a new type of sheep.

At the Saskatchewan University at Saskatoon, an experiment is to be conducted in the grading and cross-breeding of sheep, 200 specially selected fine range ewes being used as a foundation. Stud rams of several long woolled breeds may be imported from England or elsewhere.

At the Lethbridge Experimental Station in Alberta, tests of the Corriedale sheep, so well established in New Zealand, will be continued. Hardiness and adaptability to range conditions are to be determined.

At the University of Alberta, Edmonton, general environmental conditions, including where feasible such factors as temperature, humidity, rainfall, age of sheep and feeds available, will be under study, and data along similar lines will be sought from the sheep-growing areas of Saskatchewan and British Columbia as well.

For the fourth project, co-operative work is to be undertaken with one or more ranchmen, between 500 and 1,000 ewes of uniform type being bred to Corriedale rams.

The wool produced will be studied by experiments at the new Wool Research Laboratory at Ottawa, the work of which is now being carried on in temporary quarters pending the erection of the handsome new premises of the National Research Laboratories. Dr. G. S. Whitby, Director of the Division of Industrial Chemistry in the National Research Laboratories, who was formerly a Professor at McGill University, will shortly be visiting Wool laboratories in Great Britain, in order to secure guidance in connection with the new work to be undertaken at Ottawa.

THE NATIONAL RESEARCH LABORATORIES AT OTTAWA.

An Order in Council has been passed at Ottawa authorising the expenditure of $3,000,000 on the erection of buildings in that City for the service of the new National Research Laboratories. The initial expenditure originally contemplated was $1,000,000 but it is proposed to proceed with the entire enterprise at the total estimated cost mentioned. Instead of building only the front part of a building having four sides surrounding a courtyard, it is now intended to construct the whole of the units of the structure simultaneously.

It is stated that among proposed new industrial concerns in Hungary are a nitrate works, a cellulose factory, two artificial silk concerns (in one of which Italian, and in the other, German capital will participate), a new textile factory, and a margarine works in which Dutch capital is interested.

PRAGUE INTERNATIONAL TRADE FAIR.

Statistics published recently by the Economic Section of the League of Nations place Czechoslovakia seventh among the industrial nations of the world. Czechoslovak industries are not only very numerous but also of a very diversified character. Many buyers who come to Czechoslovakia found it difficult to see as much as they wished to owing to geographical decentralisation of the industries. It was of advantage to visit the Prague International Fair, held from September 1 to 8, where all industries exhibited their goods. About 3,000 firms re-

tained space and many foreign exhibitors took part, among whom were an official French Section, organised under the auspices of the Office National du Commerce Extérieur, a collective exhibition of the Soviet Republics prepared on a large scale, a Spanish section, etc. The Sample Fairs are now held not only in the Main Exhibition grounds, but also in the New Fair Palace, said to be the biggest business building in Central Europe. The Palace is a gigantic iron and concrete structure covering an area of 360,000 square feet and built in the most modern way. It also houses club rooms, reading and writing rooms, etc. For the convenience of foreign visitors a special Export Service has been established, giving free information on all questions pertaining to foreign trade. A forwarding agency, travel bureau, post and customs office are also on the premises. It is worth while mentioning that the main feature of the Fair, the New Fair Palace is a Permanent Exhibition.

APPLICATIONS FOR DYESTUFFS LICENCES IN AUGUST, 1929.

Board of Trade Announcement.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during August, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 620, of which 544 were from merchants or importers. To these should be added 28 cases outstanding on the 31 July, making a total for the month of 648. These were dealt with as follows:—

Granted—596 (of which 552 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—21 (of which 19 were dealt with within 7 days of receipt).

Outstanding on 31 August—26.

Of the total of 648 applications received, 571, or 89 per cent., were dealt with within 7 days of receipt.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated to the Society in July—

Photochemical Change of Certain Substances. By Yushichi Nishizawa.

Adsorption of Gases by Charcoal. By Takehiko Totsuka.

Catalytic Action under High Pressure at High Temperature. Catalytic Reduction of α-Naphthol. By Shinji Shono.

Sinomenine and Disinomenine XI. Position of Double Bond in Sinomenine. By Kakuji Goto and Hideo Suzuki.

Sorption of Carbon Dioxide by Active Charcoal. By Hiroshi Hirano.

Catalytic Action under High Pressure at High Temperature. I. Catalytic Reduction of Phenols. By Ryodo Amatatsu.

THE INSTITUTE OF METALS.

Synopses of Papers Presented at the Annual Autumn Meeting of the Institute, held in Düsseldorf, September 9-12, 1929.

Progress in Electric Furnaces for Non-Ferrous Metals. By M. Tama, Dipl.-Ing.

New induction furnaces of large capacity are described. They have been developed for high melting-point alloys such as nickel-brass and phosphor-bronze. Thirty-four electric annealing furnaces of the resistor type are shown to be in successful operation in a large metallurgical plant. The advantages of the use of electricity both for melting and annealing non-ferrous metals are emphasised. Recent improvements in refractory linings for melting copper alloys, devices for charging swarf into electric furnaces, and various types of electric bright annealing furnaces are described.

Pinholes in Cast Aluminium Alloys. By N. F. Bugden, Ph.D., M.Sc.

The paper describes an investigation into the causes of pinholes in sand-cast aluminium alloys, and describes the various forms of pinholes that are seen. The notes are confined largely to the observation of sand-cast test-blocks 8in. in diameter by 8in. deep.

Gas evolution at solidification is considered to be the causation factor of greatest importance, and the means whereby gases may be absorbed by aluminium alloys are discussed. Shrinkage during solidification is considered to play some part in producing pinholes.

The influence of the aluminium ingot itself, the melting and pouring temperature, the time maintained molten, the melting fuel and furnace, the rate of solidification, the turbulence of pouring, and the alloying elements are separate considered in relation to their effect on pinholing.

Properties of Locomotive Firebox Stays and Plates. By O. F. Hudson, D.Sc., T. M. Herbert, M.A., A.M.I.MechE., F. E. Ball, Ph.D., B.Sc., A.I.C., and E. H. Bucknall, M.Sc.

This paper is published by permission of the Council of the British Non-Ferrous Metals Research Association, and deals with some of the results of metallurgical interest arising out of the Research on "Copper Locomotive Stay Rods," which the Association is carrying out on behalf of the British Railways.

Of the two main sections of the paper the first is devoted to a consideration of the conditions existing in a locomotive firebox, and gives very briefly the principal results of the investigation into the causes of the wastage of stayheads in service. The main results obtained in the determination of the composition of firebox gases and temperatures of stayheads (described more fully elsewhere) are indicated, and the authors show that, while wastage is primarily dependent on oxidation of copper, the severer forms are caused by the action of water leaking between stays and plate, this leakage water bringing about the loosening of the hard adherent oxide scale normally formed on arsenical copper in a firebox, and leading to its detachment and the exposure of fresh copper surfaces to oxidation. The authors have arrived at the conclusion that leakage results from the plastic deformation of copper under the influence of thermal stresses, which leads to loosening of the fit of the stays screwed into the copper plate.

The other main section, Part II. of the paper gives the results of an investigation of the oxidation of arsenical copper in firebox atmospheres, the properties of the oxide scale formed, and the action of leakage liquid. The rate of oxidation of arsenical copper in various atmospheres has been determined within the range of 260°-600° C. The presence of small proportions of chlorine as hydrochloric acid gas causes a very great increase in the amount of oxidation in air and other atmospheres, and the presence of sulphur dioxide also causes a marked increase, both these substances being present in firebox atmospheres. There was no evidence that the presence or arsenic in the copper had any influence on the rate of oxidation. The conditions necessary to the formation of the dense, hard, and firmly adherent oxide, which is characteristic of the scale formed on copper in a locomotive firebox, have also been studied, as well as those necessary to bring about loosening of the scale under the action of leakage water.

This section also contains the preliminary results of a study of the softening and elastic properties of cold-worked copper containing small percentages of other elements. This emphasises the importance of a more thorough consideration of the mechanical and thermal properties of locomotive firebox materials, and already indicates the possibility of selecting improved materials, which should greatly reduce wastage of stayheads.

The investigation on the softening and elastic properties of copper is still in progress, but the results are given of a wide survey of the influence of other elements on the temperature of softening of copper in different degrees of cold-work. Tensile tests which have been made on a large number of these materials have included determinations of the elastic limit (limit of proportionality) at room temperature, and also in some cases at a temperature of 300° C. The object of these tests is to obtain, by alloying and suitable mechanical and thermal treatment, copper, otherwise suitable for firebox purposes, which will have and retain at service temperature a reasonably high elastic limit, say, of the order of 5 tons/in.^{2} The results have already shown that there is a reasonable prospect of achieving this object, one of the most promising alloy additions being silver, of which as small a quantity as 0.05 per cent. appears to be sufficient.

(*To be continued.*)

NOTICES OF BOOKS.

Abderhalden's Handbuch der biologischen Arbeitsmethoden. Abt. I. Chemische ethoden Teil 2. 2 Hälfte, Heft 5 *Halogenieren.* By Hugo Bauer. Pp. 2309-2548. Berlin and Vienna Urban Schwarzenberg. 1929. Price 14 marks.

Lieferung 299 of Prof. Abderhalden's Handbuch is one of the most important of the sections dealing with Chemical Methods. Like the other sections of this monumental work for biologists and biochemists it suffers from the drawback of being published separately as a part and is without Contents or an Index, although it has a concise summary at the end.

The introduction of a halogen element into an organic compound may be effected in a variety of ways. The simplest method is by direct addition to an unsaturated compound and the next is by the substitution of the halogen for a hydrogen atom in the molecule of a compound. Among other methods used for introducting chlorine and bromine into organic bodies the use of the

oxy-acids is of more value than is generally realised. Prof. Bauer also deals with the fluorine and iodine compounds and their formation.

The section commences with an account of the preparation of fluorine, chlorine, HCl, HClO, hypochlorites and the substitution of oxygen by chlorine. Bromine and iodine are then treated similarly and the greater part of the book is concerned with the use of these bodies in effecting halogenation of the commoner and important organic bodies.

This section, like all the previous ones. should find a place in all biological and biochemical libraries.

Elektrochemie der Kolloide. Von Prof. Wolfgang Pauli und Dr. Emerich Valko. Pp. xii + 648. Vienna: Julius Springer. 1929. Price 66 marks.

The Viennese authors of this extensive treatise have dedicated their work to Prof. Richard Wasicky, who has done so much for the Institute for Medical Work in Colloid Chemistry in that city. No apology is now needed to explain the importance of the prosecution of research work upon the phenomena of disperse systems, especially in biology and medicine. The vital processes themselves are intimately wrapped up with the behaviour of colloidal bodies, the chemical study of which is alone unable to explain their behaviour nature.

Prof. Pauli was a pioneer in this field and with his collaborator has written a most important volume covering the whole subject and treating in detail those points which are of greater biological significance. The volume is of outstanding merit and importance.

Forthcoming Events.

FARADAY SOCIETY.

A general discussion on "Molecular Spectra and Molecular Structure" will be held in the Physics Department of the University of Bristol, on September 24 and 25.

BOLTON'S CIVIC WEEK.

This is being celebrated with proud *éclat* from September 20 to 29. The inhabitants are now talking up to both Manchester and Liverpool and other cities.

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New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

26,465.—Hooley, L. J., and Scottish Dyes, Ltd.—Dyes. August 30.

26,348.—Jakubowitz, M. E.—Production of sodium fluorite. August 29.

26,424.—Kahl, L.—Production of anthracene. August 30.

26,318.—Soc. of Chemical Industry in Basle.—Manufacture of cellulose derivatives. August 29.

26,481.—Carpmael, A., and I. G. Farbenindustrie Akt.-Ges. — Manufacture of carbozole derivatives. August 30.

Specifications Published.

317, 736.—Barnes, R. S., Harris, J. E. G., Thomas, J., and Scottish Dyes, Ltd.—Production of sulphuric anhydride compounds of tertiary bases and the application of the products.

317,867.—British Celanese, Ltd., and Oxley, H. F.—Production of oxygenated organic compounds.

317,869.—Carpmael, A., (I. G. Farbenindustrie Akt.-Ges).—Manufacture of alkoxy-acridinium compounds.

317,716.—Carughi, A., and Paolini, C.—Process of and means for manufacturing chloride of lime.

291,100.—Eder, R.—Manufacture of polysulphides of aromatic carboxylic acids and esters thereof.

Abstract Published.

315,997.—Acetic acid.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Dilute acetic acid is concentrated to about 60 per cent. strength by freezing out the water as described in the parent Specification, and then converted into glacial acid by some process other than one making use of an addition compound of acetic acid with another substance. Thus the 60 per cent. acid may be treated with solvents in the cold, or distilled with substances forming azeotropic mixtures with water, or the vapour of the 60 per cent. acid may be treated with extracting agents of high boiling point, or substances which bind water chemically or physically may be added to this 60 per cent. acid, so that concentrated acid can be distilled off in known manner. In the examples (1) to (3) the 60 per cent. acid is treated with chloroform, ethyl chloride, and methyl chloride respectively in counter current, the operation being performed under 5 atmos. pressure in the last case; (4) and (5) the 60 per cent. acid is mixed with phosphorus pentoxide and anhydrous aluminium sulphate respectively.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

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503,589.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Minatol, Limited, 11-12, Finsbury Square, London, E.C.2. August 28th.

LYSOTAB.

504,188.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — Solidol Chemical, Ltd., Ashmead Works, Disney Street, London, S.E.1. August 28.

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

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BRITISH PATENT.

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SOME CHARACTERISTICS OF NEW GUINEA GOLD.

By LT.-COL. R. LAW, V.D., F.I.C.

There have been numerous references in the press to gold derived from New Guinea gold fields. The public have heard of the great difficulties in reaching these gold fields, and have learnt that the necessary man power is not easy to obtain, and that the transport and supply problem requires money and careful organisation to ensure reasonable comfort and security. This is not remarkable in view of the lack of information existing about New Guinea—a country which has hardly been explored geographically, let alone geologically. The climate and luxuriant growth of a tropical region, and natives who know not yet the white man, are additional obstacles to be overcome before that information is obtained, and the willing co-operation ensured for their benefit and ours. There must be no exploitation if we are to carry out our obligations as trustees of a mandated territory. Nevertheless, gold is being obtained, despite these barriers; although of low fineness and, therefore, of low money value, the gold and its manner of occurrence are rich in scientific data and present some important and interesting phenomena. It has been my good fortune to have had the privilege of examining many parcels from this field. These vary in weight and appearance considerably, but there are general characteristics which are new and worthy of record. The various types of the parcels received may be roughly classified as under :—

(*a*) Melted gold in ingots, buttons, etc.
(*b*) Unmelted gold recently roughly separated from the quartz and gangue (possibly reef gold).
(*c*) Water worn stones and pebbles carrying the precious metals.
(*d*) Alluvial dust grains, slugs, or small nuggets with a fine gold colour.

(*a*) The melted gold presents few characteristics of note. It is usually clean and of brilliant lustre, though sometimes sulphide discolourations are present. The gold value is low and varies to some extent, much silver is present, but normally only a small percentage of base metal. As the history of its treatment is unknown, no deductions are considered advisable, nor are they necessary for the purposes of this note.

(*b*) The unmelted gold is generally dull and dirty looking, obviously of a fineness of about 60 per cent. gold. Sometimes, however, there are traces or patches of gold which appear to be of greater fineness.

;uartz, sulphides, and ferruginous material re frequently associated with this form, which has every indication of recently naving been roughly crushed and separated rom the bulk of the associated quartz, etc. It may have been derived from large boulders or even reef gold. The gold is massive, foliated, and fine, with a crystalline, dendritic or filamented structure which plays its part in the subsequent development of nuggets.

(c) The water worn pebbles and stones are well rounded and occasionally discoloured with iron compounds. Some are quite dense, hard, and smooth; others show definite weathering and disintegration in progress. Metal is present which may look like fine gold; in fact, some stones seem to be mostly fine gold (a fact which will be referred to later), which is simply holding quartz and ferruginous gangue together. The foliated nature of the original metal above referred to contributes to this action. Such stones have probably been more or less at rest for a long period and subjected to little abrasion or rubbing. When the stones have been moving about, the exposed metal in veins may look more like silver than gold, and assays only about 50-55 per cent. fine.

Some stones which are soft on the outside, *i.e.*, disintegrating, show a decided concentration of gold towards the surfaces. One piece particularly, which in structure was much like sandstone, disclosed this peculiarity most definitely.

There is every indication that the metal is coalescing while the gangue is disintegrating, leaving pieces of gold with less and less quartz, etc., but still enclosing some quartz as the metal is being welded together.

The metal from this source assays 53-57 per cent. gold, and the fine gold colour is but superficial.

(d) The alluvial gold in dust, grains, slugs and small nuggets, looks like alluvial gold from any other locality. It is discoloured by iron, and has inclusions of quartz, sand, grit, etc.

The fineness appears about 95, and the touch stone may also confirm such a fineness. Yet, when melted and cast into ingots, the fineness is found to be about 50-60 per cent. In this way one's judgment, based upon the experience of years, may be completely at fault, but there is always an element of uncertainty as to the behaviour of any particular specimen.

Some of these slugs are fairly solid and of high density, while others are of low density. In some instances they can be torn apart with the fingers, but generally tools are necessary to get a proper grip. The fractured surfaces thus formed may suggest 95 per cent. gold, or upwards, unless rubbing or abrasion has taken place.

If these slugs are cut, filed, or sawn, the fineness is seen to be much lower.

TOUCH.

The touch stone value of these slugs, even with a heavy pressure, may be 90-95 fine; a second touch on the same spot gives a lower value, and if the specimen be filed or cut before making the touch, some indication of the actual fineness may be disclosed. It may rightly be deduced from numerous trials that it is not safe to estimate even the approximate fineness of nuggety New Guinea gold by touch alone, unless the superficial layer first be removed.

EFFECTS OF HEAT.

It has been observed that the external fine gold colour of the slugs disappears at temperatures below 700° C. It is therefore clear that, whatever the cause of this external fine gold colour, it is not the result of heat action. No blebs were formed in any of the specimens so far examined, nor have gases under pressure been liberated (vide Liversidge, J.C.S., 1897, p. 1125).

On raising the temperature, silvery alloy may liquate out, but the quartz inclusions, acting as a skeleton, keep the slug apparently intact.

MICRO EXAMINATION.

Some fine examples of dendritic and fern leag crystallisation were observed, these being occasionally macroscopic and with an external colour of 90-95 per cent.

Micro-sections indicated that the slug were an agglomeration of smaller grains each of which consisted of a white nucleus with a fine gold exterior as if plated. Inclusions of quartz, iron, salts, and other gangue were common, consequently the slugs were far from homogeneous.

Even the very dense slugs were found be only partially coherent, pressure or blow causing them to disintegrate and d close their structure. This would perm liquids to permeate the particles and all certain chemical actions to take pla There is little doubt that a solvent act was proceeding in these specimens of N Guinea gold.

GENERAL.

There were dark dense particles in sand and grit which looked like titanifer iron ore or cassiterite. Those exami were neither, but just quartz and gold co pletely discoloured by iron salts.

In recovering the gold from these ores, care should be taken that this apparently worthless material is not eliminated and lost. Sulphides were present in the gangue, but neither platinum nor selenium has been detected so far.

SOLVENT ACTION.

The peculiarities exhibited by New Guinea gold are due to an etched or plated external surface. It has been shown that they are not due to heat. If caused by plating, accretion, or chemical deposition, it would naturally be expected that the larger nuggets or slugs, which presumably have been longer in forming, would have a heavier and thicker coating than the smaller ones. Examination does not bear this out. If due to selective solvent action, or parting, the pieces might be expected to become finer and smaller. One sample received consisted of smaller and denser slugs with a gold assay of 91.8 per cent., and silver 7.5 per cent., showing that silver had been removed.

Several experiments were carried out in an endeavour to ascertain how solution of silver might be brought about.

Some of the stones were boiled in distilled water, the solution evaporated to one drop, crystallised and examined under the microscope. There were indications of iron, but not of salt. A flame test suggested calcium or potassium; other tests confirmed iron and chlorides.

Some of the white metal from the stone was boiled in salt solution for two hours; slight increase in colour was suspected, but it was not definite.

Salt and a trace of iron chloride were tried next and in one minute a superficial colour of finer gold resulted, and silver was detectable in solution. Then some of the melted gold from the field was tested, and similar results obtained; in one minute the colour increased, after five minutes' boiling the colour was about 90 fine.

Thus, one possible solvent has been discovered, and from the nature of its chemical action there is the further possibility of the existence of silver deposits.

NUGGETS IN THE MAKING.

From the above data it would appear that one of Nature's methods of forming nuggets is disclosed. Gold of low fineness, *viz.*, 58-56, alloyed with silver, exists in the stone and the reef. The metal is being separated from the gangue by weathering and mechanical action, and superficially acted on by solvents at the same time. Finally, the fine gold surfaces coalesce. All assayers know how readily gold cornets adhere if but touched; every layman knows how easily fine gold can be made to adhere in filling a tooth. The natural forces of water in rivers and streams appear to be quite sufficient to bring about the necessary consolidation and gradual elimination of the quartz, etc., and thereby give rise to slugs and nuggets like those found in this region

This is the first time that alluvial nuggety gold has been found, which varies in fineness from the outside inwards, and scientifically it is of interest.

In conclusion I desire to express my thanks to the Deputy Master of the Royal Mint, Melbourne, for permission to present this note.

MASS NUMBERS OF THE CHEMICAL ELEMENTS AND OBSERVATIONS ON ELEMENT FORMATION.—THIRD NOTE.

By F. H. LORING.

Two notes have been added to my article titled mainly as above.* Here is another note.

In connection with the original article (p. 1 of this Vol.) it is of possible interest to remark that it sometimes pays to follow up small and seemingly unimportant clues in studies of the kind here discussed. In particular, attention may now be drawn to the complete absence of radioactive elements in Groups I and VII of the periodic classification, referring of course to the radioactive series.

In the first article I have shown that lithium (in part) and sodium (wholly) of Group I may have been formed by the subsequent addition of a hydrogen atom to the nucleus of the original atom as in the cases, $5+1=6$ and $22+1=23$. For the full argument see pages 1 to 3.

This would imply that there was a lack of tendency for elements of Group I to form originally, and this is borne out by the complete absence of such elements in the radioactive part of the classification as stated above.

It is of interest to observe in this connection that potassium and rubidium are very slightly radioactive. This might be interpreted as meaning that they are unstable, or that they contain unstable isotopes, which accords with the views developed in this study.

* See *The Chemical News*, July 5, 1929, *139*, 1; August 16, 1929, *139*, 108; August 30, 1929, *139*, 139.

It is also to be noted that Rutherford has displaced hydrogen from the nitrogen nucleus, and nitrogen has possibly the same peculiarity as Li6 and Na23, as already indicated in the first article.

While it is possible to cite cases which would introduce a disturbing element in the general scheme of affairs, still, there is just enough systematic peculiarity to call for further study and experiment in my opinion.

Take for example the case of cæsium; this element is not radioactive. It may fulfil a mass-number requirement that makes for stability, as on the lines previously discussed.

The monumental work of Rutherford and Chadwick in breaking up elements—to cite the first successful workers in this field—should be studied in this connection.

To make a slight digression here, radioactivity, in my opinion, can be graded so as to be represented by three types, starting mathematically with one at zero (see Loring, *Nature*, 1926, *117*, 448).

1.—The *zero* type where there is no *give or take*, and therefore no change occurs. No electrons, etc., are given out or absorbed automatically or spontaneously, as in the case of practically all the common elements.

2.—The *balanced* type in which there is a *give and take* as in the case of potassium and rubidium (see citation above).

3.—The *unbalanced* type in which there is only *giving*, as in the radio-elements proper, *i.e.*, those elements of very high atomic weight.

These factors should be studied in relation to the other observations, as *three gradations* of stability seem possible—in respect of type at least.

It should be noted that the language is probably somewhat at fault, as the framing of new ideas in the absence of definite or incomplete experimental evidence is difficult, and only an approximation to the real truth can at best be expected. The word *element* as used above refers particularly to the atoms of a given element, this being understood from the context.

INDIA'S TRADE BALANCE IN JUNE QUARTER.

A rather smaller total trade than in the corresponding period of last year was accompanied by a decline from 23,45 lakhs of rupees to 19,81 lakhs in the balance of merchandise exports over imports.

POLAROGRAPHIC STUDIES WITH THE DROPPING MERCURY CATHODE. — THE DEPOSITION OF CADMIUM FROM CYANIDE SOLUTIONS.

By I. Pines.

Introduction.

According to the electro-chemical researches of A. Brochet and F. Petit,[1] and considering those described by F. Spitzer[2], F. Förster[3], A. Höing[4], M. Le Blanc and K. Schick[5], complex cyanides of metals with alkali cyanides fall into three groups :

1. Silver, mercury and cadmium, which are electro-deposited from their double-cyanide solutions with a 100 per cent. current efficiency at the reversible equilibrium electrode potential, whatever the excess of the alkali cyanide; an alternating current does not bring these metals into solution.

2. Copper and zinc, which are deposited with difficulty from their cyanide solutions, the excess of the alkali cyanide preventing the deposition entirely; an alternating current dissolves these metals into an alkali cyanide solution with an almost 100 per cent. efficiency, provided the frequency is not too great (over several thousands per min.).

3. Platinum and iron, which cannot be electro-deposited from their double cyanides.

Analogous to this electrochemical behaviour appears the chemical precipitation of the metals from their cyanides solutions : silver and cadmium may be completely precipitated as sulphides and also mercury, after strong acidulation. Sulphides of zinc and copper are precipitated in excess of alkali cyanides slowly and incompletely. Platinum and iron cannot be tested for their ions in solutions of their double cyanides.

Electrolysis with the dropping mercury cathode gives results which accord with the experience gained from ordinary electrolysis and E.M.F. measurements, affording, moreover, an exact and detailed current-voltage analysis.

The electro-deposition of mercury[6] and silver[7] from cyanide solutions has been already found to proceed quantitatively, no matter what the excess of the alkali cyanide in solution. The impossibility of the electro-reduction of the ferro-cyanide[7] and platino-cyanide[8] at the dropping mercury cathode has been demonstrated, as well as the partial electro-deposition of copper, which is entirely suppressed by an excess of alkali cyanide.

The remaining two typical electro-reductions of cyanides, *viz.*, the " reversible "

one of cadmium and the "irreversible" of zinc, which were investigated by the present author, are described below.

EXPERIMENTAL.

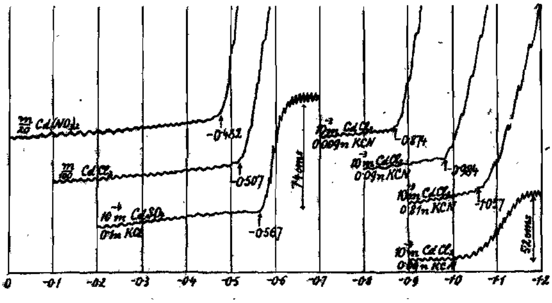
First the "deposition potential" of cadmium from a known concentration of its simple ions has been ascertained. The turning points of the 45° slope at the current-voltage curve, obtained with the ordinary polarographic arrangement and galvanometer sensitivity 10^{-8} amp. per mm, were: in a 10^{-2} molar solution of $CdCl_2$ at the cathodic potential −0.507 volt (from the normal calomel zero), and in a 10^{-4} m. $CdSO_4$ solution at −0.567 *v*. These values lead to a "deposition potential" from a solution molar in cadmium ions −0.451 v, using the Nernst formula $\pi - \pi' = 0.058 \log [Cd^{\cdot\cdot}] / [Cd^{\cdot\cdot}]'$. Here the dilute solutions are taken as completely ionised, disregarding the certain complexity of cadmium chloride ions; that this is justified shows the coincidence of the "deposition potential" value calculated from a decinormal cadmium nitrate solution, −0.482 *v*,[6] which gives $\pi_N = -0.458$ *v* (from a normal solution) or $\pi_M = -0.444 v$ (from a molar solution).

Next solutions of cadmium chloride in an excess of potassium cyanide were prepared and polarograms obtained. The solutions were, of course, freed from atmospheric oxygen by passing hydrogen through them, usually overnight, and were never allowed to come into contact with mercury, but in the atmosphere of pure hydrogen, to avoid dissolution of mercury (comp.[9] below.).

The following results were obtained (at room temperature); *C* denoting the molar concentration of $CdCl_2$:

C	Conc. *KCN*	E decomposition voltage (from curves)	π_a anode potential	$\pi_a - E = \pi$ cathodic deposition potential
	m	*v*	*v*	*v*
10^{-2}	0.81	0.245	−0.784	−1.029
10^{-3}	0.81	0.280	−0.777	−1.057
10^{-3}	0.090	0.315	−0.669	−0.984
10^{-2}	0.090	0.290	−0.648	−0.938
10^{-3}	0.0090	0.350	−0.524	−0.874
10^{-2}	—	0.650	+0.143	−0.507

The shifts of the deposition potentials, π, are represented in the graph:



CALCULATION OF THE COMPLEXITY CONSTANT.

From the "deposition potentials," π, the concentration of free, simple cadmium ions $[Cd^{\cdot\cdot}]$, existing in the cyanide solutions, were calculated using the Nernst formula. The free ions must be in equilibrium with the complex ones according to the reaction equation:

$$Cd^{\cdot\cdot} + n.CN' \rightleftarrows Cd(CN)_n^{(n-2)'}$$

and the constant must hold:

$$K = \frac{[Cd^{\cdot\cdot}].[CN']^n}{[Cd(Cn)_n^{(n-2)'}]}$$

where *n* is an integer greater than 2,

The following table contains the constants lculated for $n=3$ and 4; the concentration complex ions, $[Cd(CN)_n^{(n-2)'}]$, has been taken as equal to the molar concentration of the cadmium chloride and the concentration of cyanide ions, $[CN']$, as equal to the concentration of KCN diminished by n. c.

C	Conc. KCN	$[Cd^{\cdot\cdot}]$	$[CN']$ for $n=3$	$[CN']$ for $n=4$	K for $n=3$	K for $n=4$
10^{-3}	0.81	2.5×10^{-21}	0.78	0.77	11.8×10^{-20}	8.5×10^{-20}
10^{-3}	0.81	2.5×10^{-22}	0.81	0.81	13.3 ,,	11.4 ,,
10^{-3}	0.090	10^{-19}	0.087	0.086	6.59 ,,	0.74 ,,
10^{-2}	0.090	6.3×10^{-18}	0.060	0.050	13.6 ,,	0.39 ,,
10^{-3}	0.0090	6.3×10^{-16}	0.0060	0.0050	13.6 ,,	0.039 ,,

Evidently the constant holds only for $n=3$, indicating that the majority of ions are in the form of complexes $Cd(CN)'_3$; this is best seen from the two last measurements, where a ten-fold dilution leads to a hundred-fold increase of free cadmium ions.

To express the complexity of the double cyanide of potassium and cadmium, $KCd(CN)_3$, according to Bodländer, the reciprocal of the constant K is used, *viz.*, 8×10^{18}.

The complex cyanide of cadmium is usually regarded as $K_2Cd(CN)_4$ and the solid salt is known; this does not, however, exclude the relations as found under the conditions here investigated, *viz.*, at small concentrations of cadmium, far from saturated. The ions $Cd(CN)_4''$ are also assumed in the work of H. Euler,[10]) who measured concentration cells consisting of cadmium in complex cyanide solutions; however in his work atmospheric oxygen has not been avoided and the accuracy was small.

Conclusions.

An important result to mention is that the "diffusion" (or saturation) current, which manifests itself on the current-voltage curves in the form of a "wave (see the Fig.), is of about the same dimensions, whether due to the free cadmium ions from a solution of the chloride, or from a solution of the complex cyanide. Thus the height of the "diffusion" current in a 10^{-4} m $CdSO_4$ solution (in presence of 0.1 *n* KCl) is 7.4 cms, whereas in excess of KCN (0.09 *n*) it is 5.4 cms. This difference is easily explained by the slower rate of diffusion of the complex ions and the depressing effect strong electrolytes produce on the diffusion currents.

The fact, however, that the "wave" appears in a very dilute solution of the simple cadmium salts just as in the potassium cyanide solutions containing a trace of cadmium, solutions containing a trace of cadmium, shows that the electro-deposition of cadmium takes place as readily from cyanide solutions as from those of the simple salts. The "deposition potentials" from cyanide solutions agree, moreover, with the reversible equilibrium electrode potentials, calculated thermodynamically. For such reversibility in the electro-deposition the ionic equilibrium at the cathode must be strictly maintained and during the deposition of cadmium restored instantaneously.

The author is obliged to Professor J. Heyrovsky for the suggestion of this research and for his kind help.

Literature.

1 A. Brochet and F. Petit: *Z. Electrochem.*, 1904, x, 909.
2 F. Spitzer: *ibid*, 1905, xi, 345.
3 F. Förster: *ibid*, 1907, xiii, 561.
4 A. Höing: *ibid*, 1916, xxii, 286.
5 M. Le Blanc and K. Schick: *Z. physical. Chem.*, 1903, xlvi, 213; *Z. Elektrochem.*, 1903, ix, 636.—M. Le Blanc: *ibid*, 1905 xi, 8, 705.
6 N. Demassieux and J. Heyrovsky: *Bull. Soc. chim.* 1929, xlv, 30.
7 E. B. Sanigar: *Rec. trav. chim.*, 1925, xlvi, 549.
8 B. Gosman: *ibid*, p. 605.
9 N. V. Emelianova: *ibid*, p. 534.
10 H. Euler: *Ber.* 1903, xxxvi, 3404.

Summary.

Cadmium deposits at the dropping mercury cathode completely and reversibly from solutions of its double cyanide with potassium, whatever be the excess of potassium cyanide.

From the shifts of the deposition potential with the concentrations the dissociation of the complex cyanide into the simple ions is calculated; it is deduced that in fairly dilute solutions complex anions $Cd(CN)_3'$ are formed, their complexity constant being 8×10^{18}.

The Physico-Chemical Institute of the Charles University, Prague.

—From the *Collection of Czechoslovak Chemical Communications.*

CYANAMID, ITS USES AS A FERTILISER MATERIAL.

By F. E. Allison, Senior Chemist, Fertiliser and Fixed Nitrogen Investigations, Bureau of Chemistry and Soils.

(*U.S.A. Department of Agriculture.*)

Introduction.

Cyanamid is one of the oldest of the nitrogenous materials produced by artificial processes from atmospheric nitrogen. It is used chiefly as a fertiliser, either applied alone or in commercial mixtures, although a certain percentage is converted into various chemicals for industrial and agricultural uses. The large tonnage manufactured and the present interest of the public in all forms of atmospheric nitrogenous fertilisers make it seem advisable to summarise our knowledge of the behaviour of the material when applied to the soil. The particular need for a discussion of the use of cyanamid is that it has very peculiar properties, which decidedly limit its use under practical conditions. Before discussing this, however, it may be desirable to describe briefly its manufacture and properties.

The raw materials used in the making of cyanamid are coal, coke, limestone, and nitrogen from the air. The process of manufacture consists of three principal steps : (1) The production of calcium carbide; (2) the separation of nitrogen from the air; and (3) the final production of calcium cyanamide from calcium carbide and nitrogen.

The first step of the process involves the production of lime from limestone, which is a simple operation consisting merely of heating the coarsely crushed stone in a kiln at a temperature of about 2,000° F. until it is decomposed. The lime is then mixed with coke and heated in an electric furnace to calcium carbide. At frequent intervals the molten carbide is tapped from the furnace into iron cars, is allowed to cool, is crushed, and is thoroughly powdered.

The second step consists of securing pure nitrogen from the air. Normal air contains nearly 80 per cent. of this element, mixed mostly with oxygen but also with carbon dioxide, water vapour, and relatively small percentages of various other gases. In order to secure the nitrogen free of other constituents, the air is liquefied and by distillation pure nitrogen is obtained.

The third and final step consists of passing the pure nitrogen gas into ovens filled with powdered calcium carbide, with which it combines if the reaction is started by first heating a small part of it to nearly 2,000° F. The heat generated by the reaction carries the process to completion, requiring usually from one to two days in the large ovens commonly used to-day. After it has cooled the calcium cyanamide is ground to a fine powder, water is added to decompose the remaining traces of carbide and convert any free lime present into the hydrated condition, and a small amount of mineral oil is mixed with the product to decrease dustiness.

Properties and Uses.

Cyanamid usually contains about 60 per cent. calcium cyanamide, 20 per cent. free lime, 11 per cent. free carbon, 2.5 per cent. water, and small amounts of silica, iron, and aluminium oxides. It has a total nitrogen content of about 21 per cent. The large amount of lime present, mostly as calcium cyanamide and slaked lime, gives the commercial cyanamid a distinctly alkaline reaction and causes it to react vigorously with any acidic materials with which it may be mixed. Physically, is is a black powder having excellent drilling properties. It is, however, somewhat dusty, even after oiling. The black colour is due to the inert carbon present and is of no significance. Workmen who handle the material constantly occasionally show skin inflammation. When exposed to the air, cyanamid slowly absorbs carbon dioxide and moisture, with the production of a surface crust and a slight increase in volume. The change is so slow that it is not an appreciable factor in the commercial use of the material.

It has been estimated that about 75 per cent. of the total world production of cyanamid is applied directly to the soil as a single fertiliser material. Most of this amount is used in Europe. Approximately 9 per cent. is used in commercial mixed fertilisers, almost entirely in the United States. Perhaps nearly 11 per cent. is used in the manufacture of ammonium phosphate and ammonium sulphate, while an additional 5 per cent. is changed into ammonia, and various other chemicals for industrial uses.

Fertiliser Practices in Europe and the United States.

When the large tonnage of cyanamid used as fertiliser in Europe and the comparatively small quantity used in the United States are considered, it is logical to ask the reason for the difference. The explanation is largely the fact that in most of the countries of Europe a more intensive agricultural system is followed. For the most part the farms are small, labour is cheap, and farm machinery is used on a small scale only. Usually the fertiliser ingredients are broadcast singly from two to four weeks before

planting, in contrast to our common practice of drilling a complete fertiliser in the row in contact with or near the seed. The result is that European practices are almost ideal for obtaining the largest yields from crops fertilised with cyanamid.

In attempting to market cyanamid on a scale in America comparable to that in Europe, the producers have faced difficulties owing to the inherent properties of the material which limit its use in mixtures. Where used in improper combinations, particularly in large proportions with superphosphate, bad results have frequently been noted, but where used according to the best European practices, equally good results have been secured. This usually requires a change in farm practices, and hence limits the use of the material.

TRANSFORMATIONS IN THE SOIL.

The chemical changes which cyanamid undergoes in different soils are rather complex and can be mentioned only in part. Under optimum moisture conditions there is a rapid conversion to urea, which in turn is broken down to ammonia by biological and chemical action. Small amounts of other compounds, such as dicyanodiamide and guanylurea, both of which are undesirable, may be formed at the same time. These latter compounds, particularly dicyanodiamide, greatly retard the formation of soil nitrates, and are to a large degree responsible for the slow action of cyanamid. They also probably account for many of the injuries reported in the earlier literature. With our present knowledge of the characteristics of cyanamid and how to use it the chances of injuries from such decomposition products are small. They are of importance usually only under abnormal conditions, such as where very old cyanamid is used, where improper mixtures are applied, where excessive quantities are used, where soil conditions are unfavourable for nitrate production, or where the cyanamid is not uniformly mixed with the soil.

The importance of the character of the soil needs to be emphasised, since the degree of success to be expected from the use of cyanamid is dependent to a considerable extent on the medium in which it is placed. Soils which are either very sandy, strongly acid, unusually heavy, peaty, or poorly drained and aerated are not usually suitable for cyanamid fertilisation. Such environments are not favourable for the rapid production of urea, ammonia, and finally nitrates. Loam soils, which are intermediate in physical properties, are usually the most satisfactory. This is very likely to be true for other fertilisers as well, but to a greater extent in the case of cyanamid, because few commercial fertiliser materials must undergo so many changes before becoming plant foods. As has already been pointed out, cyanamid has the added handicap of being the source of agriculturally undesirable compounds which may be produced under unfavourable conditions.

The manner of application of cyanamid influences very markedly the rate and type of transformations which take place. If it is applied at moderate rates during cool weather to a suitable soil, the desirable changes may be expected. Certain of the first transformation products, when present in appreciable concentrations, are harmful to most plants. This toxic effect is ordinarily of short duration and may be of no consequence for small applications. To avoid any possible injury, however, it has been found most satisfactory to apply the fertiliser about two weeks before planting. Where this is impractical the probability of resultant harmful effects may be reduced by thorough mixing of the material with the soil.

The necessity for uniform and thorough mixing of the cyanamid with the soil is of much more importance than in the case of other fertilisers, for the following reasons: (1) the formation of desirable nitrogenous transformation products is favoured; (2) cyanamid is more toxic per unit of nitrogen in the larger concentrations than other common nitrogen carriers and hence a small or moderate application might produce injuries in spots where applied irregularly; (3) cyanamid contains lime in a form that is very harmful to seeds, plants, and micro-organisms if the concentration at any one place is excessive; and (4) undesirable nitrogenous compounds are not produced to so great an extent if the cyanamid particles are in direct contact with the soil. In support of these statements, farm practice has shown that top-dressing of actively growing crops or other methods of use where the material is not well mixed with the soil often produce a retardation of growth.

It may seem unnecessary to discus quality, for the cyanamid sold by the manu facturers in this country is of good quality A very small percentage of the cyanami perchased by the retail store or farmer may however, not be used the year purchase and if it is improperly stored there is deterioration of the material, due chiefly t the formation of dicyanodiamide, which objectionable in cyanamid and later in soi for three main reasons; (1) It is so ver

slowly decomposed in soils that it is doubtful if it can justly be considered as a fertiliser. Any cyanamid nitrogen converted into this form may in one sense be considered as lost; (2) it is extremely toxic to the soil bacteria which produce nitrates, and hence its presence in appreciable concentrations may result in nitrate starvation for the crop; (3) there is some evidence that it is a direct poison to certain plants. Undoubtedly, the effect on nitrate production is the greatest factor, and this effect may persist for several weeks. Some crops are more susceptible to deteriorated cyanamid than others, but the evidence on this subject is rather meagre.

Cyanamid in Mixed Fertilisers.

The majority of the nitrogenous mixed fertilisers manufactured in the United States are compounded with cyanamid, which is usually used in these mixtures at the rate of 30 to 60 pounds per ton of mixture. The quantity which may be used is directly proportional to the quantity of superphosphate present. When mixed with superphosphate the lime in cyanamid combines with any free acids present and with a portion of the water-soluble phosphoric acid. If too much is used a reversion of a considerable part of the phosphate to a less available form takes place, together with the production of agriculturally underisable forms of nitrogen.

The reasons for using cyanamid in mixed fertilisers, in addition to the fact that a cheap form of nitrogen is supplied, may be largely summarised in the one word conditioner. The lime neutralises any free acids present in the mixture, thereby preventing bag rotting, and improves the mechanical condition by its drying action. The result is the production of a mixture which is more easily drilled and less liable to cake.

Commercial fertilizer mixtures in which cyanamid has been used at not to exceed 60 pounds per ton usually contain little or no calcium cyanamide a few hours after they are mixed. Urea is the chief of the nitrogenous transformation products, but small amounts of other compounds may also be formed. Dicyanodiamide does not form in quantities, except where the cyanamid is mixed with superphosphate in bulk, in proportions much higher than those commonly used. In the preparation of cyanamid-superphosphate mixtures, the phosphate should be as dry as possible and the temperature be kept from rising appreciably by mixing in small lots or thin layers.

Attempts to produce a cheap available source of phosphorus that is neutral or basic and hence suitable for mixing with cyanamid in unlimited proportions have been made. The phosphate carriers of this type are basic slag and calcined phosphate, both entirely satisfactory but produced in too small quantities to be in very general use. Should these materials or others having similar properties be produced on a large scale in the future and be used in mixtures, it is probable that the quantity of cyanamid which might be used could be increased somewhat above the present practice. There would, however, be a decided limit to the increase.

THE GOVERNMENT CHEMIST.

Abstract from Annual Report for Year Ending March 31, 1929.

The total number of samples examined in the course of the year including those dealt with at the chemical stations was 499,289, as compared with 491,039 in the preceding year, an increase of 8,250.

There has been an increase in the number of samples examined at Clement's Inn Passage of 24,441, but decreases at the Custom House branch and at the Chemical Stations of 11,853 and 4,338 respectively.

The Hydrocarbon Oils Duty has involved the examination of over 12,000 samples for assessment of duty on importation, or drawback of duty on exportation. The samples consisted largely of articles in which hydrocarbon oil was one of the ingredients, and the quantity and character of the oil had to be determined. The additional work has been met to some extent by re-organisation. Many samples which are examined for oils may also contain other dutiable substances, such as alcohol, esters, and chemicals on the Key Industry List, which must be tested for, and determined if present. Formerly the examination for spirit and other specific ingredients was made at the Custom House laboratory, but by transferring this work to Clement's Inn Passage, similar classes of samples (composite spirits and oil goods, and K.I.D. Chemicals) have been brought into one section, with economy of time and working. It will be seen from the portion of the report dealing with imported spirituousp preparations that 14,600 were examined, but of these 6,150 were also examined for hydrocarbon oils and for other duties, and are included in those sections, the re- under the head of spirituous preparations.

There has again been a very large increase in the number of samples of tobacco examined in connection with payment of drawback on exportation, 74,415 compared with 44,865 in the previous year and 17,049 two

years ago. It yas pointed out a year ago that the increase then was caused by the manufacture of cigarettes for export from duty-paid leaf. This change-over in manufacture has extended, and moreover it affected only a portion of the year ending 31 March, 1928, but covered the whole of last year. In addition there was an increase in exportation, bringing more samples in its course.

Sugar samples show an increase of about 7,000 over the previous year, arising from the new arrangements necessitated by the discontinuance of bonded sugar refineries.

The most important decreases are those in wine and tea. The samples of wine have fallen from 99,391 to 85,703, and of tea, from 41,149 to 28,896. The number of samples of cocoa preparations also shows some decrease.

It may be noted that in addition to the food samples recorded as undergoing special tests for conformity with the Preservatives, etc., Regulations, samples of imported dairy produce to the number of 1,551 were examined for preservatives in connexion with the examination of those goods for other purposes.

ADMIRALTY.

The contracts branch submitted 68 samples of food on tender for report as to conformity with specification and opinion as to relative merits. The technical examining officers at the victualling yards forwarded 139 samples from supplies. Some of these were examined with the object of preventing the issue of canned foods contaminated with metals, others for general composition, or for agreement with tender, or conformity with specification.

Other samples to the number of 101 included soaps, canvas, cordage, plated ware, fabrics for the nature of the soluble salts and dye, oilskin capes, insecticides, gold thread, tin, and tinplate.

In addition to the examination of the above-mentioned samples of food and general stores, the determination of the salinity of 384 samples of sea-water was carried out for the Hydrographic Department.

DEPARTMENT OF AGRICULTURE FOR SCOTLAND.

One hundred and eighty-four samples of imported dairy produce and 9 waters are dealt with under "Ministry of Agriculture and Fisheries."

Six samples of peat were examined for acidity and a determination was made of the composition of the mineral matter.

MINISTRY OF AGRICULTURE AND FISHERIES.

The samples examined for the Ministry of Agriculture and Fisheries may be classified as follows :—

(1) Imported dairy produce and margarine.
(2) Butter and margarine taken at factories.
(3) Sheep dips.
(4) Water and pollution of rivers.
(5) Sea water.
(6) Substances under the Fertilisers and Feeding Stuffs Act.
(7) Substances under the Merchandise Marks Act.
(8) Miscellaneous articles.

GENERAL NOTES.

RUHR CHEMICAL CORPORATION REDEMPTION OF BONDS.

The redemption at 100 and interest of $106,000 (£21,200) principal amount of 6 per cent. bonds, due 1948, of the Ruhr Chemical Corporation is announced by Dillon, Read & Co., of New York, as fiscal agent. Bonds are payable October 1 at the offices of Dillon, Read & Co., in New York, of M. Sambuel & Co., Ltd., London, Mendelssohn & Co., Amsterdam, Nederdandsche Handels-Maatschappij, Amsterdam and the Credit Suisse, Zurich.

The bonds now to be redeemed are par of the $4,000,000 (£800,000) issued in 192[illegible] by Dillon, Read & Co. for the Ruhr Chemical Corporation—a company formed by th principal coal and steel concerns of Ger many for the purpose of producing syn thetic fertilisers from waste coke-oven ga A credit of $3,000,000 (£600,000) w recently granted to the corporation by t same banking interests.

OPTICAL AND RADIATION PYROMETERS.

It often happens, when the question measuring high temperatures is under co sideration that the user is in doubt wheth he should employ an optical or a radiat pyrometer. Assistance in making t just issued by the Foster Instrument Co pany, of Letchworth, wherein the capaci and limitations of these two types of py meter are conveniently contrasted.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.

E. GREEN & SON, LTD., WAKEFIELD.

The chief items in this company's exhibit are a standard vertical-tube economiser with scrapers and a tri-tube economiser of the type of which there are over 1,250,000 square feet of heating surface now at work.

The standard type consists of vertical cast-iron tubes, 4⅜in. in external diameter, and 9ft., 11ft. 6in., or 13ft. in length, made up into sections of 4, 6, 8 or 10 tubes in width. These sections are erected in parallel, and are connected at the top by plain branch pipes and at the bottom by access branch pipes running along lengthwise on opposite sides. All these branch pipes are outside the brick chamber which encloses the economiser sections. The exterior of the tubes is kept free from soot by scrapers which travel slowly and continuously up and down, the soot falling into a pit formed by the brickwork foundations. The operating mechanism for the scrapers is fixed on the top of the economiser outside the chamber, and the scrapers are supported to the gearing by chains. This type of economiser is so well known that it does not call for detailed description. Despite the various modifications in economiser design which have become established during recent years, this type still represents a big demand from users of steam-raising plant.

The tri-tube economiser is of the horizontal type and has been designed to meet the demand for an integral boiler-economiser unit in plants where head-room is limited.

The apparatus with supports and connecting bends can be arranged to rest on the boiler supports, or if desired, on independent joints, and can be fitted either inside existing casing or provided with separate casing. The sections contain three tubes each, and are supported back and front on vertical supports, with freedom to expand in any direction. The outside tubes of each section are fitted at each end with ring stays, thus rendering them suitable for use at high pressures. The method of feeding introduces the cold water at the lower portion of the economiser, thus obviating any sudden differences of temperature when changing from stand-by conditions to full load. Either horizontal or vertical baffles can be used, and the apparatus is easily accessible for examination and cleaning. Various models and similar exhibits illustrate other activities of the makers.

ECO POWER, LTD.

This concern is a subsidiary of E. Green & Son., Ltd., Wakefield, formed eighteen months ago for the purpose of selling the Foster economiser, the patents and rights of which were acquired by E. Green & Son, Ltd.

The outstanding feature of the exhibit is an actual Foster economiser which has been constructed for a London power station, the particulars of which are as follows :—

Overall dimensions : 14ft. 5in. long; 5ft. 2in. wide and 8ft. 9in. high. Heating surface 3,888 sq. ft. orking pressure 320 lbs. per sq. in. Inlet water temperature 180° F.; outlet 280° F. Flue gases inlet temperature 680° F.; outlet 398° F. Evaporation 70,000 lbs. per hour.

The construction of this economiser, which is shown by representative sections on the stand, comprises solid cold-drawn steel tubes on which are shrunk cast-iron gilled rings, machined internally to give absolute contact with the tube. This construction gives the resistance to pressure which is characteristic of the steel tube and the resistance to external corrosion by the flue gases which is associated with cast iron. The large area of heating surface which is presented by the gilled tube without involving large overall dimensions, is an important feature of this apparatus. It will be recalled that many modern power stations, for example, Barking, Poplar, Derby, St. Pancras, Sheffield, Leeds, Hull, Leicester, Bedford, Brimsdown, and Scarborough, have installed this type of economiser, while 14 have been installed at the power plant of Synthetic Ammonia and Nitrates, Ltd., 8 of these being for the high-pressure plant (800 lbs. per square inch), which is the largest industrial high-pressure steam-raising plant in Europe.

An interesting apparatus on view at the stand, demonstrates the importance of high velocity of water-flow through an economiser, a feature which is embodied in the Foster design. A jet of water is shown impinging on the centre of a polished steel plate, so that the reducing velocity from the centre outwards, until the critical velocity is reached, can be clearly seen. The change in the nature of flow at the critical velocity is very definite and while from the centre up to that point, the constant flow of water over the plate produces no visible corrosion of the polished surface, beyond the wave formed at the critical point very definite corrosion quickly sets up, as can be observed on examining the plates being tested. This demonstration is instructive in the effect of high velocity in moving air bubbles from the surface of economiser tubes, and demonstrates the reason for adopting velocities higher than the critical point in designing the Foster economiser.

ENDERS FOR TARTAR EMETIC AND CARBON TETRACHLORIDE FOR EGYPT.

The office of the Commercial Secretary at airo reports that the Department of Public ealth, Cairo, is calling for tenders, to be resented in Cairo by the 26 October, 1929, or the supply of 660 kilos of tartar emetic nd 5,800 kilos of carbon tetrachloride.

Firms desirous of offering chemicals of ritish manufacture can obtain further parculars of this call for tenders upon appliation to the Department of Overseas 'rade, 35, Old Queen Street, London, .W.1. Reference number B.X. 5673 should e quoted.

VISIT OF H.M. SENIOR TRADE COMMISSISONER IN INDIA.

The Department of Overseas Trade anounce that Mr. T. M. Ainscough, C.B.E., His Majesty's Senior Trade Commissioner in India, is now in this country on an official visit.

Mr. Ainscough will be available at the offices of the Department during the period September 25 to October 11, to interview manufacturers and merchants interested in the export of British goods to India and will later visit a number of industrial centres in the Provinces.

Firms desiring interviews with Mr. Ainscough in London should apply at once to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 332/1/29.

MEMORANDUM FOR BUSINESS VISITORS TO CANADA.

His Majesty's Senior Trade Commissioner in Canada (Mr. F. W. Field) has prepared a "Memorandum for the Use of Business Visitors to Canada." It is in the form of a booklet of 37 pages, and deals with those subjects, a knowledge of which is likely to be of value to a traveller, especially one making a first visit.

Copies of the Memorandum can be obtained on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (the Reference No. C.X. 3125 should be quoted).

"SILVER SPOT" IN VICTORIA STREET.

The new exhibition rooms of Allen-Liversidge, Ltd., the welding and acetylene engineers and manufacturers of Dissolved Acetylene, which were opened on September " described as a silver spot in Victoria Street.

They are something new. Shining steel shopfronts have been seen before; but it has not been the engineering industry which has taken best advantage of the decorative value of the new material which their own science has produced. Allen-Liversidge, Ltd., are pioneers in the display as well as in the production of their equipment.

The showrooms have been exeecuted to the design of Mr. Joseph Emberton, A.R.I.B.A.

A DEADLY BACILLUS.

At the Sanitary Inspectors' Conference at Lowestoft on September 4, Professor Leonard Hill, director of the Department of Applied Physiology of the National Institute for Medical Research, in his presidential address, referred to a deadly bacillus, whose name he did not disclose, but which, he said, was easily cultivated.

If men were as susceptible as guinea-pigs were to the toxin produced by this bacillus, he said—and there was reason to think they were—it would appear that one gramme, say a saltspoonful, of the dry toxin would suffice to kill a million. The toxin acted if inhaled or if it fell on the eye as a powder. If men set out to prepare such a toxin and scatter it by aeroplane, what would be the use of the panoply of war? Was it not time, then, to end the waste of money on preparations for war, and apply the money so saved to preventing disease?

Speaking on diet and vitamins, he said it was now known that the vitamin labelled E was necessary for breeding. It was curious to think that mankind, by adding or withholding this, could raise children, some as sterile workers, others as breeders, as the bees did. While general recognition of what made an adequate diet would have a great effect on the future health of the nation, it was necessary that abstinence should be taught. There was much over-eating and drinking. The cocktail habit was not a good one. It had been proved conclusively by exact research that alcohol in doses above small ones, especially when taken on an empty stomach, diminished skill and lessened efficiency. Alcohol was thought to exhilarate; it really lessened control and so loosened the tongue. For motor-drivers and air pilots alcohol was therefore dangerous, while useful for after-dinner speakers and those who wanted to be slightly anæsthetised and forget troubles.

It would be a valuable reform, Professor Hill continued, if men took to wearing

washable outer garments, and laundry men might well set out to try and provoke this fashion. Women had reduced their clothing, all washable, to a weight of two or three pounds, while man continued to over-clothe himself with three or four times this weight. The reform most needed at the moment was the open neck. The loose trouser was convenient and comfortable for this climate, and underclothing could and should be lightened. The world would not easily accept the view that the Prime Minister and his Cabinet, the leaders of the professions, and captains of business should be dressed as Boy Scouts, but it could be persuaded to adopt the fashion of the open neck. In hot weather, custom should not restrict the taking off of coats in places of business and entertainment.

At the afternoon session there was a discussion on the housing situation.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Under the Order in Council dated 6 February, 1928, the Lord President of the Council has appointed the Rt. Hon. Lord Rayleigh, Sc.D., F.R.S., Sir Arthur Balfour, K.B.E., Sir William H. Bragg, K.B.E., D.Sc., F.R.S., and Sir James Walker, D.Sc., Ph.D., LL.D., F.R.S., to be members of the Advisory Council to the Committee of the Privy Council for Scientific Research.

The following members of the Advisory Council have retired on completion of their terms of office :—

Sir H. C. Harold Carpenter, F.R.S., Dr. G. C. Clayton, C.B.E., Sir Richard T. Glazebrook, K.C.B., F.R.S., and Sir James H. Jeans, D.Sc., LL.D., Sec.R.S.

REFORM IN THE NOMENCLATURE OF ORGANIC CHEMISTRY.

A committee of the Union Internationale de la Chimie pure et appliquee has been formed to report upon the reforms needed in the nomenclature of Organic Chemistry. The chairman of the committee is Prof. A. F. Holleman (Holland) and the secretary, M. Jean Gerard (France). The other members are, Prof. R. Baker (U.S.A.), Prof. G. Barger (Great Britain), Prof. M. Betti (Italy), Prof. R. Marquis (France), Prof. Minovici (Rumania), Prof. van Romburgh (Holland), Dr. V. Vesely and Prof. E. Votovek (Czechoslovakia), Prof. S. Weil (Poland). A number of suggestions have already been made and embodied in a preliminary report.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

(Continued from page 190.)

Effect of Temperatures Attained in Overhead Electric Transmission Cables. By A. v. Zeerleder, Dr.-Ing., and P. Bourgeois, D.Sc.

The increases of temperature produced by a current of electricity in transmission cables made, respectively, of copper, pure aluminium, steel-aluminium, and Aldrey were measured. Cables consisting of these materials were submitted to temperatures lower than the usual annealing temperatures for periods ranging over several months up to one year, and the effect on the mechanical properties was examined. It was found that Aldrey is not affected by temperatures which will seriously diminish the tensile strength of copper. Cables consisting of aluminium alloys having undergone previously an appropriate heat-treatment—such as Aldrey—are thus able, in spite of their lower electrical conductivity, to be loaded with higher current densities than copper cables, without danger of slow annealing.

The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part II. The Results of Seven Years' Exposure to Air at Birmingham. By J. Newton Friend, D.Sc., Ph.D., F.I.C.

Fifty-four bars of ferrous and non-ferrous metals were exposed to air on the roof of the Birmingham Central Technical College for seven years, and an account is given of the 17 non-ferrous bars. The metals examined included tin, lead, nickel, zinc, aluminium, and various coppers and brasses. All resisted corrosion much more efficiently than the wrought iron and carbon steels. Nickel proved less resistant than copper. Aluminium ranked with lead, tin, and stainless steel in offering a very high resistance to corrosion. The influence of arsenic on copper is discussed.

Idiomorphic Crystals of Cuprous Oxide in Copper. By C. Blazey, M.Sc.

A description is given of idiomorphic crystals of cuprous oxide in copper, containing 0.48 per cent. oxygen, which had been heated for a long time at a temperature above 800° C. The grain size of the copper was large and the cuprous oxide crystals were arranged in groups with uniform orientation, but in any one grain of copper the orientation of the groups varied

It does not appear to be necessary to have either slow cooling through the solidification range or a high oxygen content for the development of idiomorphic crystals of cuprous oxide. Long heating at a high temperature is necessary with, possibly, a favourable relationship to the crystallographic planes of the copper matrix.

NOTICES OF BOOKS.

Hydrogen Ions. By HUBERT T. S. BRITTON, D.Sc., F.I.C. Pp. xiv + 516. London : Chapman & Hall, Covent Garden, W.C.2. 1929. Price 25s.

The hydrogen ion concentration has long been recognised as an essential factor in biochemical processes and has contributed to the advances in that field. In other branches of chemical science it is now being realised that the same phenomenon also plays an important role. The present volume considers the various electrometric and colorimetric means for determining the concentration of H-ions and then goes on to deal with the applications of this knowledge in general chemistry, including volumetric and gravimetric analysis. Applications in industrial chemistry are on the increase and the author has thought fit to give brief outlines of certain manufacturing processes where necessary. These include such widely separated industries as the electro-deposition of metals, leather manufacture and tanning, sugar manufacture, pulp and paper making, brewing, baking, water purification, ceramics and the textile and dye industries.

This monograph, one of a new series on Applied Chemistry, is an important contribution to the scientific and technical literature, giving as it does a comprehensive survey of a very important subject which has hitherto only been treated in a disjointed manner.

Short Stories in Science. By J. G. CROWTHER. Pp. viii + 213. London : Messrs. George Routledge & Sons, Broadway House, Carter Lane, E.C. 1929. Price 5s.

In writing of the achievements of science in a style which is both scientifically accurate and at the same time readily understandable to the non-scientific reader Mr. Crowther is performing a most important task.

The present *Short Stories in Science* cover a very wide field. They include an account of the latest views regarding the [illegible] such Catastrophies as volcanoes and lightning, the Ultimates as exemplified by "smashing the atom," and "the birth of matter," what nebulium is, Power, nitrogen from the air, Life's Mechanism and Science and Literature.

This does not exhaust the range of subjects covered by Mr. Crowther. He also includes brief sketches of three Indian scientists and Pavlov and there is also a section on Refrigeration.

Whilst the author does not go very deeply into all these matters he at least gives a good picture of the contributions of science to the benefits of mankind and the amenities of modern life.

Chemists are so often reproached that they have so much to tell the world and yet are unable to impart their knowledge in an understandable manner. The Press, we are told, is only too anxious to afford space for scientists to relate their discoveries and yet it is seldom that a newspaper refers to any scientific discovery in a manner that is both accurate and intelligible to other scientists. Prominence is still given, however, to sensational claims which on investigation often prove to be unfounded. It is therefore refreshing to learn that some of the chapters of Mr. Crowther's volume appeared originally in the *Manchester Guardian.* He also retaliates against the view that scientists alone are unable to make their meaning clear and illustrates his remarks with quotations from the works of several great literary men which are far from clear in their meaning. The book can be safely recommended to all interested in science.

J. G. F. D.

Die specielle Relativitätstheorie Einstein's und die Logik. 2nd vermehrte und verbesserte Auflage 1929, von DR. J. H. TUMMERS, Privatdozent an der Universität Nymegen. Verlag von Otto Hillmann, Leipzig (Auch zu beziehen vom Verfasser zu : Tegelen by Venlo, Holland.) Preis M. 1.50 (1s. 6d.).

In this brochure the Special Theory of Relativity is refuted from the standpoint of Logic, without recourse to mathematical arguments. It is shown that the concept of the "Relative Time" is logically an unpermissible one. The attempts to refute the logical errors are here discussed.

The structure of the fine, clearly written and strictly logical pamphlet may be judged from the Table of Contents.

The vicious circle, which forms the basis of the Special Theory of Relativity, is here clearly exposed : Time is relative because the two fundamental postulates harmonise

(Principle of the Constancy of the Velocity of Light and the Principle of Relativity) and these two principles harmonise . . . . because Time is relative. The two above-mentioned principles are however . . . . contradictory, which *nota bene* is acknowledged by Einstein himself.

The little book is very simple, very clearly written and strictly logical and this second edition has gained much in clarity through the treatment of the subject in lectures (Tummers is a " Privatdozent ").

DR. W. TOMBROCK.

Forthcoming Events.

SOCIETY OF PUBLIC ANALYSTS.

The next meeting of the Society will be held on Wednesday, October 2, at the Chemical Society's Rooms, Burlington House, London, W.1., at 8 p.m.

The following papers will be read :—

" Chemical Tests in Relation to Fur Dermatitis." By H. E. Cox, M.Sc., Ph.D., F.I.C.

" Demonstration of a Nomogram for Use in Gas Analysis." By J. H. Coste, F.I.C.

" The Composition of Irisb Winter Butter." By P. S. Arug, A.C.G.I., M.Sc., F.I.C.

" Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. XVI. Observations on Tartaric Hydrolysis. XVII. The Quantitative Precipitation of the Earth Acids and Certain other Oxides from Tartrate Solution." By W. R. Schoeller, Ph.D., and H. W. Webb.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

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THE HARBEN LECTURES, 1929.

These lectures will be delivered in the Lecture Theatre of the Institute by Rudolph A. Peters, M.C., M.A., M.D., Whitley Professor of Bio-chemistry, University of Oxford, on " Co-ordinative Bio-Chemistry of the Cell and Tissues," as follows :—

Friday, October 18, at 5 p.m.—" Cell Surfaces," with reference to the part played in the integration of Cell process by adsorption. —Lecture I.

Friday, October 25, at 5 p.m.—" The Ministers of Metabolic Chanbe." Experimental researches upon the nature and distribution of the water soluble Vitamins.—Lecture II.

Friday, November 1, at 5 p.m.—" Tissue Anarchy," as illustrated by the present position of our knowledge upon the changes produced in the higber animal by lack of Vitamin B.—Lecture III.

No Tickets of Admission are required.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

27,108, 27,109.—Briers, F., and Dunn, J. S., and Imperial Chemical Industries Ltd.—Production of phosphorus oxychloride. September 6.

26,679.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of derivatives of sulphonated fatty acids. September 2.

26,998.—I. G. Farbenindustrie Akt.-Ges —Separation of chloride from solutions. September 5.

27,225.—Imperial Chemical Industries, Ltd.—Production of titanium oxide. September 7.

27,006.—Slater, V. W.—Manufacture of barium carbonate. September 5.

Specifications Published.

318,269.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.)—Production of antirachitic products.

288,270.—Barrett Co.—Distillation of tar.

306,105.—Holzverkohlungs-Industrie Akt.-Ges.—Obtaining concentrated volatile aliphatic acids.

318,815.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.). — Manufacture of orthohydroxy-benzyl-amine arsinic acids and their aroyl-derivatives.

300,611.—Imperial Chemical Industries, Ltd.—Treatment of black powder.

Abstract Published.

315,895.—Obtaining gaseous unsaturated hydrocarbons.—Johnson, J. Y., 47, Lincoln's Inn Fields, London. (I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany).

Hydrocarbons, cracking; destructive hydrogenation; acyclic hydrocarbons.—Gaseous unsaturated hydrocarbons are obtained from oils, tars, etc., by heating the initial materials to 600-800° C. in the presence or not of cracking catalysts and gases such as water vapour, separating con-

ensates from the resulting gases by fractional liquefaction by the application of pressure and by cooling in stages and rectifying the said condensates by fractional distillation. Equal parts by weight of gas, oil and water vapour are passed over an alloy of iron, chromium and nickel. From 1 metric ton of oil a gas mixture is obtained comprising 200 kgs. ethylene, 150 kgs. propylene, 50 kgs, amylene and butylene and 200 kgs. of a mixture of methane, carbon monoxide and nitrogen besides about 360 kgs of likuid products consisting mainly of benzines and tar. The gaseous products are separated by compression to 200 atmospheres and cooling to -10° C., further cooling to -90 ° C. and finally to -120° C., whereupon the pressure is released and the remaining gases cool down to a very low temperature and are utilised for cooling in the earlier stages. The condensates thus obtained are rectified in columns and ethylene and propylene of 90 per cent. purity are obtained. Specifications 248,375 and 251,652 are referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

NATROLETS.

505,163.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Bayer Products, Limited, 81 to 84, Basinghall Street, London ,E.C.2. September 4.

PRUFITE.

505,100.—Chemical substances used for agricultural and horticultural purposes. —Seedolin Company, Limited, 21, Lower Mall, Hammersmith, London, W.6. September 4.

PLEXIGUM.

498,574.—Chemical substances used for agricultural ,horticultural, veterinary and sanitary purposes.—Röhm and Haas Aktiengesellschaft, Weiterstadterstrasse 42, Darmstadt, September 4.

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

WANTED, *Chemical News*, January 6, 1929.—G. E. Stichart & Co., 2, Star Yard, Carey Street, London, W.C.2.

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BRITISH PATENT.

It is desired to secure the full Commercial Development in the United Kingdom of British Patent No. 158,852, which relates to "Distillation of Tar," either by way of Sale or the grant of Licences on reasonable terms.

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POLAROGRAPHIC STUDIES WITH THE DROPPING MERCURY CATHODE. THE DEPOSITION OF ZINC FROM CYANIDE SOLUTIONS.

By I. PINES.

Next to cadmium cyanide solutions, described in the previous communication, solutions of complex zinc and potassium cyanides were polarographically investigated.

The course of investigations was the same as in the case of cadmium solutions. First, solutions of zinc chloride were prepared in a large excess of potassium cyanide : 10^{-2}, 10^{-3} 10^{-4} molar $ZnCl_2$, each of them in n, 0.1 n and the more dilute ones also in 0.01 n KCN. When these solutions were electrolysed with the dropping mercury cathode arrangement (exactly as described in the previous communications) and the current-voltage curves registered by the polarograph, at once the fundamental difference from cadmium solutions with excess of cyanide was ascertained : the polarograms coincided with those of the pure potassium cyanide solutions, indicating no zinc deposition up to the decomposition voltage of potassium cyanide (see Fig. I, curves 1 and 2).

Thus next solutions containing little or no excess of potassium cyanide over the ratio 1 mol $ZnCl_2$: 3 mols KCN were prepared in order to allow a larger concentration of zinc ions so that the deposition of zinc might be observable on the curves before that of potassium or—with a smaller sensitivity of the galvanometer—on the saturation current due to potassium.

For that purpose zinc cyanide was precipitated from a solution of zinc chloride by potassium cyanide, the precipitate thoroughly washed and then suspended in a 0.01 n solution of potassium cyanide. The polarograms of this solution and of 10 times diluted show *no deposition after that of* potassium, however exhibit three distinct deposition stages at potentials more positive than the deposition of potassium, *viz.*, at -1.03 v. -1.28v. and -1.4 v. in the 0.01 n KCN solution saturated with $Zn(CN)_2$ (see Fig I, curve 3).

First it was investigated, whether these three "waves" are not due to impurities in the reagents used, although this was improbable since the dimensions of the "waves" in the ten times diluted solution increased. The mercury used in these experiments was, as usual, treated with nitric acid and twice distilled; solutions of alkali salts tested polarographically using the solution of zinc chloride was prepared by

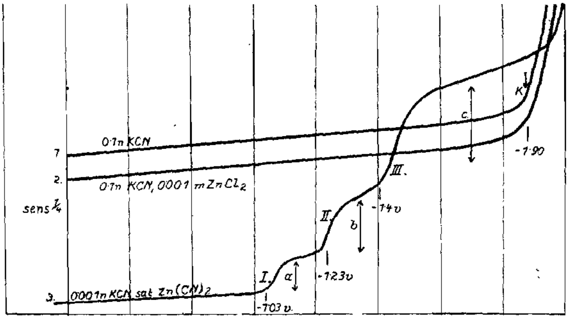


Fig. I.

dissolving purest (Kahlbaum's) zinc in dilute hydrochloric acid, insufficient to dissolve the whole piece of metal; the polarogram of this solution also showed no impurity present. The same test for purity was obtained with the potassium cyanide solution (*e.g.*, see Fig. I, curve 1). Also other potassium cyanide solutions saturated with zinc cyanide, for which reagents of ordinary purity were used, showed on polarographic analysis the same three waves as those prepared from the purest material.

None of the three waves can be due to the evolution of hydrogen since hydrions never deposit from neutral or alkaline solutions at the dropping mercury cathode before the potential of -2.8 *v.*; moreover on increasing the concentration of potassium cyanide the third wave, which only falls within the potential of the hydrogen "wave," increases although the concentration of hydrions decreases.

So far it has thus been ascertained that from solutions containing an excess of cyanide no zinc deposits before the deposition of potassium and that from cyanide solutions, saturated with zinc cyanide, three stages of electro-reduction occur due to zinc. Now the transition was sought between the two cases by electrolysing polarographically solutions containing a gradually increased excess of cyanide. The composition of the solutions was:

	1	2	3
molar conc. of $ZnCl_2$:	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}
normal conc. of KCN:	1.8×10^{-3}	2.25×10^{-3}	2.7×10^{-3}

A solution $10^{-2}n$ in KCN and 0.5×10^{-3} molar in $ZnCl_2$ has been polarised earlier and showed no "wave" before the deposition of potassium.

The polarogram of solutions 1, 2, and 3, is represented in Fig. II. The curve 1 due to solution 1, shows the three waves with the heights in the ratio 32 : 85 : 180 mm. curve 2 due to solution 2, has the ratio of the three waves 2 : 26 : 190, whilst curve 3 of solution 3, shows no first wave (at -1.03 v.), a wave 5 mm high in the place of the second and 145 mm high the third one.

To ascertain how the saturation currents of the three processes (*i.e.*, the height of the waves) change with the cyanide content,

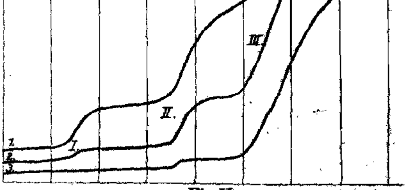


Fig II.

solutions were prepared with less potassium cyanide than necessary to form the zinc cyanide, *viz.*,

molar con. of $ZnCl_2$:

4	5	6
0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}

normal conc. of KCN :

4	5	6
0.9×10^{-3}	0.45×10^{-3}	0.18×10^{-3}

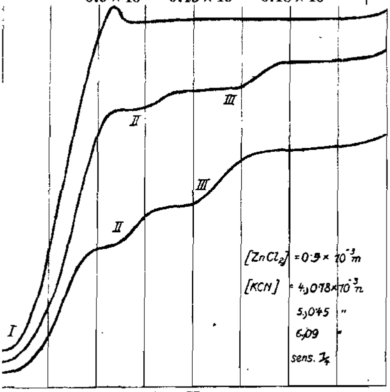


Fig. III.

The polarogram of these solutions is shown in Fig. III; the sensitivity of the galvanometer was $^1/_{10}$ of that used in the calculations of waves in Fig. II. The ratio for the solution 4 is 250 : 80 : 120, 5, 530 : 40 : 60, and 6 780 : 0 : 0, merely the first wave being observable. The last curve corresponds to that of a pure solution of zinc chloride of about the same concentration, *coinciding exactly in the deposition* potential. This proves that the electro-reduction process to which the first wave is due is the deposition of zinc from the free zinc ions, present in a concentration of ca *gr. eq.* 10^{-4} per litre. This is evident not only from the height of the first wave, but also from the deposition potential occuring at −1.08 v. when considering that the "molar deposition potential" of zinc is −0.87 v. Then the two other waves must be due to a zinc deposition of another kind.

A number of similar solutions was polarographically examined and always the three waves were obtained when the solutions contained about equivalent amounts of zinc and cyanide and disappeared whenever the solution contained an excess of cyanide.

DISCUSSION OF THE RESULTS.

Explanation of the three waves :

Polarograms II and III show that if we gradually increase the cyanide concentration in a solution of zinc chloride, the wave due to the deposition of free zinc ions continually decreases, the other two first increase to decrease again in excess of cyanide ions.

To explain the increase of current at the second and third wave let us discuss the cathodic processes by which one substance in solution—in our case zinc cyanide—causes increases of current at several potentials. These processes might be :

1. Several stages of reduction,
2. Deposition of products of different free energy,
3. Deposition from several forms in solution which are not in perfect equilibrium.

The supposition 1 has to be rejected in the case of a metal, like zinc, with perfect stable valency. By the process 2, the deposition of zinc in a "super-active" condition is meant, such as has been found, *e.g.*, in the electro-deposition of iron at the dropping mercury cathode.[1] The supposition 2 however has to be allied with 3, since it is *improbable that from the same sort of particles* in solution at various potentials zinc in different metallic states should be deposited. Thus the only *possibility remains* that zinc is present in solution in several forms, free ions and complexes, between which equilibrium is not established quickly enough to maintain the deposition at the first potential, *viz.*, at −1.080 v. If the particles in solution, *e.g.*, free ions and complex ions of zinc, were in a perfect equilibrium, from all zinc should deposit at the same (first) deposition potential, since the removed free ions would be quickly restored by the dissociation of the complex.

The supposition 3 is strengthened by the *possibility* of the *existence* of several complexes containing zinc and cyanide ions, *viz.*,

$$Zn^{\cdot\cdot}+2CN' \longrightarrow Zn(CN)_2$$
$$Zn^{\cdot\cdot}+3CN' \longrightarrow Zn(CN)_3'$$
$$Zn^{\cdot\cdot}+4CN' \longrightarrow Zn(CN)_4''$$
$$Zn^{\cdot\cdot}+5CN' \longrightarrow Zn(CN)_5''' \text{ etc.}$$

The view that here between the free and complex ions the equilibrium, if once disturbed, establishes comparatively slowly, also suggests the slow and incomplete precipitation of zinc sulphide by sulphuretted hydrogen from such solutions, and further the evidence from ordinary and alternating

current electrolysis; these latter facts will be discussed below.

The most probable explanation is thus that at the potential of the first wave, *i.e.*, at −1.03 v., the free zinc ions deposit, which exist in zinc cyanide solutions after the equilibrium has been established. The saturation current after the first deposition potential, indicated by the height of the first wave, is thus a measure of the concentration of free zinc ions, $[Zn^{\cdot\cdot}]$. At more negative potentials than −1.1 v. the solution surrounding the mercury cathode is exhausted from free zinc ions, which only diffuse in, through the exhausted layer, but still contains all the complexes. At the next increase of current, at −1.28 v., zinc from the first complex begins to be deposited and again the saturation current (*i.e.*, the second wave) is reached when the layer surrounding the cathode is exhausted from the first complex, the diffusion current being furnished by this complex. Similarly at the third increase of current, the deposition of zinc from a higher complex starts. Thus the heights of the second and third wave have to be proportional to the concentration of the two complexes.

The dependence of the heights of the three waves on the concentration of potassium cyanide is then in accordance with the law of mass action; the more cyanide is added, the less must be the concentration of free ions and the greater the concentration of complexes; however, when excess of cyanide is present, the lower complexes disappear yielding higher complexes, riches in cyanide, which have a still more negative deposition potential, until prevailingly the most complex zinc-cyanide anion is formed which, like most anions,[2] is not reduced at the dropping mercury cathode.

(*To be continued.*)

EARLY CHEMICAL PROCESSES IN RAYON PRODUCTION.

In an article on the rise of rayon industry in Bolton, a writer in the current issue of the *Rayon Record*, describes the early chemical processes for rayon production and states that "the similarity between the processes employed in the early plant to those of the present day is especially marked in the preparation of viscose. No divergence in principle is apparent in this section, the methods being identical with those now utilised except in points of detail. Passing to the spinning process, however, a divergence is noted both in the character of the setting baths employed to coagulate the viscose and also in the employment of a double setting bath. The baths employed in 1902 consisted of ammonium sulphate, into which the yarn was first passed, then carried through a bath of ferrous sulphate. One function at least of this latter bath was to reduce the evolution of sulphur compounds during spinning, as even with the small output of the early manufacture of viscose rayon the presence of these gases had been found to be troublesome. It was noted that the gases evolved during spinning had a bad effect upon the eyes of the operatives, and attempts, which were only partially successful, were made to extract the fumes by means of a fan connected to a pipe on the top of the machine. In view of the importance attached to the efficient removal of spinning gases at the present time, and the fact that their successful removal has followed the application of the principle adopted during those early days, the methods followed by the producers of early plant is especially noteworthy.

After the spinning of the yarn the cakes were reeled in a similar manner to that now employed, after which there is another main divergence in process. The adoption of a drying process intermediate between the washing and the desulphurising and bleaching of the yarn had not commenced. For this reason, the stretching of the yarn during the first drying process was not employed. The process adopted consisted in passing the yarn through a washing process to remove the salts left from spinning, followed by an acid treatment, second washing, and then soaping. The whole of these processes were carried out on a single machine, the yarn being traversed under sprays as in a modern bleaching machine. A modification of the treatment of the yarn after reeling consisted in the employment of a brine wash instead of the first wash, after which souring, or acid treatment, with the second wash and soaping followed. The use of brine assisted in the removal of any sulphur precipitated on the yarn.

It will be noted that the chemical methods employed for coagulation and finishing of the yarn, although they have been replaced for yarn production by the modern acid setting baths, followed by desulphurisation with sodium sulphide, bleaching, and souring, are in some instances still employed in principle and with minor modifications for the production of "Cellophane or transparent paper."

HYDRO ELECTRIC PROGRESS IN CANADA.

The mid-year review of Hydro-Electric Development in Canada just issued by the Minister of the Interior at Ottawa states that during the first six months of 1929 new developments completed and additions to existing plants made during the period totalled almost 200,000 horsepower. Undertakings now under way, when completed to their designed capacity will involve a total installation exceeding 2,000,00 0horsepower.

The statement also mentions that a number of other developments are projected, or in prospect, these including the 500,000 horsepower scheme of the Beauharnois Light, Heat and Power Company on the St. Lawrence River, and the proposed plants of the Shawinigan Company on the upper reaches of the St. Maurice River, where installations for the development of no less than 1,000,000 horse-power are contemplated.

Waterpower developments in operation in Canada at the present time represent a total installation of 5,500,000 horsepower. Progress has taken place during the past six months in eight of the nine Provinces of Canada, the exception being Prince Edward Island, and many undertakings of a very important character are under construction.

British Columbia.

At its Ruskin plant on the Stave River, the British Columbia Power Corporation expects to bring into operation the first unit of 42,500 horsepower by the autumn of 1930 and a second unit of similar size in 1931. The same concern is actively proceeding with a large depelopment at Bridge River at which it is intended to complete an initial installation of 56,000 horsepower in 1933. In the interior of the Province, the West Kootenay Power and Light Company has completed its 75,000 horsepower undertaking at South Slocan on the Kootenay River and has a projected development of 8,000 horsepower on the Pend d'Oreille River, while projected developments also include one of 15,000 horsepower for the East Kootenay Power Company at Phillips Canyon on the Elk River.

Alberta.

In Alberta, good progress is reported on construction of the plant for the Calgary Power Company at the Ghost River site on the Bow River, where initial installation will be 36,000 horsepower. The plant is expected to operate in November.

Saskatchewan.

In Saskatchewan, the Churchill River Power Company, a subsidiary of the Hudson Bay Mining and Smelting Company, is constructing at Island Falls on the Churchill River a power plant designed to include six units of 14,000 horsepower each, three of which will be put in as the initial installation. This plant is the first hydro-electric power development in the Province of Saskatchewan and it is expected to be in operation before the end of 1930. A transmission line about 65 miles in length will carry power to the Flin Flon mine and smelter.

Manitoba.

Two large hydro-electric power developments are under construction on the Winnipeg River. The Northwestern Power Company, a subsidiary of the Winnipeg Electric Company, is making good progress at Seven Sisters Falls, where the ultimate installation will be six 37,500 horsepower units representing a total generation of 225,000 horsepower. The initial installation of three units is expected to be in operation before the end of 1930. At Slave Falls, the City of Winnipeg, has awarded the contract for construction of a development which will contain eight units of 12,500 horsepower, or a total of 100,000 horsepower, with initial installation of two units expected to operate in 1931.

Ontario.

A number of new projects are under construction in Ontario. The Hydro-Electric Power Commission is installing the tenth unit of 58,000 horsepower at Queenston Falls on the Niagara River. Work has been resumed on the 54,000 horsepower plant at Alexandra Landing on the Nipigon River, which is to be completed in 1931. Work has taken place on two small developments in the Muskoka region and near North Bay, and on a 5,000 horsepower installation now proceeding at the Ear Falls dam, recently completed at the outlet of Lac Seul on English River, this latter power to supply the Red Lake mining district and to be completed about January, 1930.

The International Nickel Company of Canada, Ltd., has recently completed a 28,300 horsepower installation at the Big Eddy dam on Spanish River, and an initial installation of 18,770 horsepower has been completed by the Algoma District Power Company at High Falls on the Michipicoten River. The Canada Northern Power Corporation is contemplating the development

of 13,000 horsepower at The Upper Notch on the Montreal River 20 miles from Cobalt the energy from which is needed to augment the supply for the Ontario mines.

QUEBEC.

Installations already completed in the Province of Quebec this year include the fourth unit of 34,000 horsepower at the Farmer's Rapids Plant of the Gatineau Power Company, as well as the second unit of 25,000 horsepower for the same Company at its Bryson plant on the Ottawa River. Unit number eight of 43,000 horsepower has been added by the Shawinigan Water and Power Company at their plant at Shawinigan Falls; and the City of Sherbrooke has completed a 5,800 horsepower plant at Westbury on the St. Francis River.

In Quebec, furthermore, construction is being rapidly pursued on several very large developments. These include the immense plant being erected by the Alcoa Power Company at Chute a Caron on the Saguenay River, this being designed for an ultimate installation of one million horsepower, four 65,000 horsepower units being scheduled for completion in 1931. The plant of the Montreal Island Power Company on the Riviere des Prairies, near Montreal, is expected to have in operation late this year its initial installation of six 8,800 horsepower units; and the James McLaren Company is erecting a plant at High Falls on the Lievre River designed for an initial installation of 90,000 horsepower, ultimately to be increased to 120,000 h.p., the project including a 25,000,000,000 cubic feet storage reservoir and a 250-ton pulp and paper mill.

The 1,000,000 h.p. projects of the Shawinigan Water and Power Company at three or four sites on the St. Maurice River; a further 80,000 horsepower development by the Gatineau Power Company at Nigger Rapids on the Gatineau River; the installation by the Chats Falls Power Company of a 30,000 horsepower plant at Chats Falls on the Ottawa River; and the 500,000 horsepower development of the Beauharnois Light, Heat and Power Company, Ltd., on the St. Lawrence River, are included as prospective developments in the Province of Quebec, as well as a total of about 180,000 horsepower representing additions to existing plants of the Shawinigan Company at Grand' Mère, Shawinigan Falls and La Gabelle.

NEW BRUNSWICK.

In New Brunswick, the St. John River Power Company has added the second unit of 20,000 horsepower to its development at Grand Falls on the St. John River, and the third unit is scheduled for completion this year. On Nipisiguit River, the Bathurst Power and Paper Company is adding 5,000 horsepower.

NOVA SCOTIA.

The activities in hydroelectric development outlined as being carried on in Nova Scotia are those of the Nova Scotia Power Commission, these including three developments on the Mersey River of 7,750 horsepower, 10,600 horsepower, and 12,700 horsepower, to fulfil a contract for power with the Mersey Paper Company calling for delivery of 20,000 horsepower on January 1, 1930; also a 3,000 horsepower development at Tusket Falls on Tusket River to supply Western Nova Scotia Electric Company and the Cosmos Imperial Mills Limited, both of Yarmouth.

TRANSMISSION LINES.

The mid-year review also features some of the outstanding developments in electric transmission in Canada, including the construction of the second 220,000-volt line to carry Gatineau River power to Toronto; the 132,000 volt line across New Brunswick to carry power from Grand Falls to the 500-ton newsprint mill being constructed by the New Brunswick International Paper Company at Dalhousie on Chaleur Bay; and the extension of the transmission system of the Calgary Power Company in the district between Calgary and Edmonton in the Province of Alberta.

RAPID INCREASE IN CANADIAN MINERAL PRODUCTION.

Confirming the Report cabled by Reuter on September 4, the Dominion Bureau of Statistics at Ottawa has now forwarded to the High Commissioner of Canada in London a preliminary statement relative to the mineral production of Canada during the first six months of 1929. It may be recalled that a new output record valued at $274,989,487 was achieved during the calendar year 1928, this being 11.2 per cent. over the total for 1927. The progress registered last year continues at a greater pace in 1929, the output of metals and non-metals during the half-year showing a value 17.2 per cent. above that for the corresponding months in 1928. There is thus every possibility that further new records will be established when the totals for the present calendar year are compiled.

The production of metals and non-metals from Canadian ores reached a value of $123,702,384 during the half-year, as compared with $105,682,571 for the six months ended June 30, 1928.

METALS.

Greater outputs were recorded in respect of all metals except arsenic, cobalt, lead and of the metals of the platinum group, although in the case of cobalt and lead the value of the production was higher owing to the better prices realised. Silver production was higher in volume but slightly lower in value. Copper, gold and nickel were the leading products in point of value, followed by lead, silver, zinc, cobalt and a group of less important metals including cadmium, platinum metals, arsenic and bismuth.

Copper showed the most outstanding gain, rising 28.9 per cent. over the quantity produced in the first half of 1928. Higher prices during the first half of 1929 raised the period to 68.1 per cent. above the figures the total valuation of the copper output for the first half of the preceding year; the value of Canada's copper production now exceeds that of gold.

Gold production reached a total of 940,005 fine ounces valued at $19,431,626 or 3.7 per cent. above the figures for the first half of 1928.

Nearly 55 million pounds of nickel were produced in the half-year ended June, 1929, showing a rise of 18.3 per cent. in quantity and 21.1 per cent. in value over the corresponding totals for the first half of 1928. Refined and electrolytic nickel produced in Canada in the first half of 1929 reached a total of 34,891,047 pounds as compared with 21,955,829 pounds in the first half of the preceding year.

While lead production was very slightly less than during the first half of 1928, better prices prevailing during the period raised the total output value to $8,116,385, or more than the total for the first half of 1928.

Silver production showed a gain of more than half a million ounces, or 4.7 per cent., to a total of 11,807,341 fine ounces.

Zinc production figures were up 10 million pounds to a total of 108,830,850 pounds valued at $5,955,962 or 11 per cent. higher in quantity and 14.8 per cent. greater in value than during the first half of 1928.

NON-METALLICS.

Coal, natural gas and crude petroleum showed a marked gain in every item. Crude petroleum produced during the half-year showed an increase of 55.9 per cent. over the figures for the first half of 1928, and the value was 70.6 per cent. greater than during the first six months of the preceding year. Alberta's production rose from 229,060 barrels in the first six months of 1928 to 405,970 barrels during the first half of 1929. Non-metallic minerals, with the exception of actinolite, barytes and gypsum, all showed higher output figures for the half year, the gain for those other than fuels being no less than 20.3 per cent.

The most important member of this group is asbestos, production of which rose 17.5 per cent. over the figures for the first half of 1928. Canada's exports of asbestos in the half-year ended June, 1929, reached a value more than one million dollars above the level established in the first half of 1928. The greatest gains in output were in the tonnage of shingle stocks, millboard and paper stocks. Important gains were also reported in the output of gypsum, salt, magnesite, quartz, feldspar, pyrites, talc, mica, phosphate and graphite.

Employment in the Canadian mining industry showed a gain of 4 per cent. during the half year, though at the end of June the increase was nearly 7 per cent.

Canada's mining industry continues to reflect the initiative and untiring industry of a people whose faith in their heritage has been and still is the chief spur to discovery and development. In a long and profitable production record starred with rich rewards to early sponsors, it has won an important place in the economic life of the Dominion and has established Canada as a very real factor in the mineral trade of the world.

GENERAL NOTES.

£26,000,000 FOR WORK AND WAGES.

NATION'S GREAT LEGACY FALLS DUE.

British industry will benefit to the colossal extent of £26,000,000 annually, from October 1, when the Rating Relief Act comes fully into force.

Already agriculture has benefited to the extent of £2,500,000 by the application of rating relief to that industry, which was freed from rates in April last—six months earlier than was originally planned. Agriculture under the Act gains by more than £5,000,000 a year, or approaching £100,000 a week.

The vast remainder of the £26,000,000 goes to the benefit of manufacturing industries which, from the commencement of this month, will be relieved of three-quarters of the crushing burden of rates, which has hung upon them like a millstone. Rates have increased, in general, from £97,000,000 in 1913-14 to £175,000,000, and they have advanced most in the depressed areas in which the great basic industries are largely concentrated.

ARGENTINA AND THE BRITISH EMPIRE.

An Empire Trade Exhibition in Buenos Aires is now being organised for six weeks during February, March and April, 1931. This project, initiated by the British Chamber of Commerce in Buenos Aires, has the warm approval of all leading and commercial bodies in Great Britain. Anglo-Argentine interests, both at home and abroad, have given it their strong support and, in addition, have subscribed substantial guarantees.

Support from Exhibitors, both merchants and manufacturers, is invited to enable this Exhibition to attain its object. That object is to place British trade with Argentina more on a par with British purchases and investments there; to demonstrate not only to Argentina, but also to all South America, that British initiative and British goods, backed by British credit, so far from declining, are preparing to reach higher levels than ever before.

All communications regarding the Exhibition should be addressed to :— The General Manager, British Empire Trade Exhibition, Buenos Aires, 1931, 5, Parliament Mansions, Orchard Street (off Victoria Street), London, S.W.1.; or, locally, to the Exhibition Offices at Calle Reconquista 46, Buenos Aires.

THE BISMUTH SITUATION IN *CANADA.*

Bismuth ore is not mined in Canada although, according to Mr. Arthur Buisson, of the Mines Branch of the Dominion Department of Mines, Ottawa, a small recovery of bismuth has been obtained for several years from the treatment of the silver ores of Northern Ontario, and, since December, 1928, from the treatment of the lead-zinc ores of British Columbia. Bismuth is mainly used in the manufacture of pharmaceutical products. A smaller proportion is also used in so-called fusible alloys.

At Deloro, Ontario, the Deloro Smelting and Refining Company, which treats the silver-cobalt-nickel arsenical ores of Cobalt and adjoining areas, produces in addition to silver, arsenic, cobalt and nickel oxides, lead bullion containing gold, silver and bismuth. This bullion is exported for refining to the United States, and its bismuth content was reported to be 14,000 lbs. in 1928, and 15,000 lbs. for the first six months of 1929.

In British Columbia the Consolidated Mining and Smelting Company completed in the latter part of 1928 a plant for the electrolytic treatment of bismuth residues obtained in the electrolytic treatment of lead bullion. These residues contain in addition to bismuth and some lead nearly all the silver, antimony and copper contained in the bullion. After the elimination of the silver and other metals the resulting bismuth residue is melted and poured into bars in which form it is marketed. The plant operates only intermittently and produces about 3 tons of bismuth a month.

Imports in Canada of bismuth and bismuth salts are negligible and amounted respectively in 1928 to 3,892 lbs. valued at $6,832, and 36,705 lbs, valued at $49,923.

The present price of bismuth at New York in ton lots is 1.70 c. per lb. For many years the American price has been uniformly the European price, plus duty. On this basis the price is maintained a little below the European parity, plus duty.

SAFEGUARDING OF KEY INDUSTRIES.

Renewal of Orders.

Board of Trade Announcement.

The question of the renewal of the Safeguarding of Industries (Exemption) No. 5 Order 1928, No. 1 Order 1929, and No. 2 Order 1929, made under Section 10 (5) of the Finance Act, 1926, is now under consideration by the Board of Trade. The articles covered by these Orders are :—

Acid hydrocyanic anhydrous; acid lactic which satisfies the requirements of the British Pharmacopœia; acid oxalic; amidopyrin (pyramidon; dimethyl-amidoantipyrine); ammonium perchlorate; barbitone (veronal; malonal; malourea; acid diethyl barbituric; diethylmalonylurea; hypnogen, deba); bromural (dormigene); celtium oxide; chinosol; cocaine crude; dial (acid diallyl barbituric); dicyandiamide; didial (ethyl morphine diallyl barbiturate); dysprosium oxide; elbon (cinnamoyl para oxyphenyl urea); erbium oxide; ethylene bromide; eukodal; europium oxide; furfurol; gadolinium oxide; glycol ethers; guaiacol carbonate (duotal); holmium oxide; hydroquinone; integrators (planimeter type); R. lead acetate; lead tetraethyl; lipoiodin; lithium carbonate; lithium hydroxide; lutecium oxide; metaldehyde; methyl chloride; methyl cyclohexanol methyl adipate; methyl sulphonal (diethylsulphonemethylethylmethane, trional); nickel hydroxide; papaverine; phenacetin (acetparaphenetidine); phenazone (antipyrine; phenyldimethylpyrazolone; analgesin; anodynine; dimethyl oxychinizin); phenetidine para-; phytin; piperazine

(diethylene-diamine; dispermin); planimeters; R. potassium chlorate; potassium ethyl-xanthogenate (potassium xanthogenate); potassium guaiacol sulphonate (thiocol); R. potassium hydroxide (R. potassium caustic; R. potassium hydrate); R. potassium permanganate; pyramidon-veronal; quinine ethyl-carbonate; radium compounds; resorcine (resorcinol); salol (phenyl salicylate); samarium oxide; styracol (guaiacol cinnamate); sulphonal; synthalin; terbium oxide; thulium oxide; urea (carbamide); vanadium-silica compounds specially prepared for use as catalysts for sulphuric acid manufacture; ytterbium oxide.

Section 10 (5) of the Finance Act, 1926, is as follows :—

" The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Communications on this matter should be addressed to the Principal Assistant Secretary, Board of Trade, Great George Street, London, S.W.1., within one month from the date of this notice.

September, 1929.

ELECTRICAL REGULATIONS IN NEW ZEALAND.

The Office of His Majesty's Trade Commissioner at Wellington has forwarded reprints of (1) the schedule of amendments of the Electrical Supply Regulations, 1927; (2) the schedule of amendments of the Electrical Wiring Regulations, 1927, which were published in the *New Zealand Gazette* of 4 July.

These reprints are available for loan to British firms interested on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. B.5701 should be quoted.)

Miss Julie L. V. McCord, Librarian of the Geological Survey (U.S. Department of the Interior) for more than 21 years, retired on September 2. Mr. Guy E. Mitchell is her successor.

INTERNATIONAL CHEMICAL TOUR OF EDUCATION TO EGYPT (PALESTINE) WITH AN OPTIONAL EXTENSION TO INDIA.

The suggestion of Primarius Dr. Friedrich Barach, of Vienna, has had a signal success.

About one and a half years ago he had formed a plan of enlarging the skill and knowledge of his colleagues by means of journeys in foreign countries, thus enabling them to study medical conditions and methods and to get intimately acquainted with the customs and peculiarities of such countries.

Within this short period of time he has been successful in arranging six journeys to foreign countries comprising three continents, the membership consisting not only of physicians from the succession states but also of doctors from countries much further removed. This last fact is at the same time a proof of the cultural importance of Vienna which has already earned a reputation as a " town of congresses."

The project of the next journey may well be called bold as it proposes to bring its members as far as India and to give them an opportunity of getting acquainted with the customs and culture of India as well as with canitary conditions.

The departure is planned for December 12, 1929, from Trieste by steamer via Venice, Fiume, Bari, Brindisi, Patras. Piraeus (for Athens), Canea, Candia to Alexandria and Cairo. After a stay of several days in this latter town the party will separate. Whilst one part will travel to Upper Egypt (Luxor, Assuan), and possibly continue to Palestine, the second part will embark at Port Said on December 25 for Karachee via Suez and Massaua. The intention is to visit the towns of Lahore, Delhi, Jaypure, Agra, Bombay and amongst other items inspect Lady Dufferin's Hospital in Karachee, Lady Harding's Medical College and Hôspital in Delhi, the Eve Hospital in Agra and the Arthur Road Hospital in Bombay.

Physicians (also from abroad) wishing to join this tour are invited to apply by letter for further information to :— Aerztliche Auslands-Studienreisen, Wein, I, Biberstrasse II, Austria.

The production of coal in July was generally greater than in the same month of last year. The output of pig iron and of crude steel was so without exception.

MATTER AND LOGIC.

By Dr. W. Tombrock.

The Dawn of Chemical Thought and the Proton.

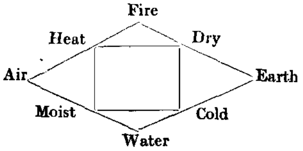
In the works of Thales we find *movement* essential to perceptible material phenomena or changes : παντα ρει . . ." He regarded water as the source of all matter." (Druce : A Brief Outline of the History of Science, 1925, p. 6. Published by *The Chemical News*.)

Empedocles points out the influence of *love and enmity* ; he thus deals with conceptions which according to our view of matter are not purely material but partly psychical. The four elements, earth, water, fire and air fight against one another or they form a mutually harmonious connection. There is everywhere attraction and repulsion. In the elements the four primary properties, heat, cold, moisture and dryness, are to be found in pairs :

" Earth	...	Cold and dry.
Air	...	Hot and moist.
Fire	...	Hot and dry.
Water	...	Cold and moist."

(Druce, *loc. cit.*, p. 10.)

In these properties one can observe love and hate once more.



Democritus draws attention to *atoms* : " It was suggested by Democritus (about B.C. 460-370) that matter could be repeatedly subdivided until the ultimate particles or atoms were reached. All changes of matter were regarded by him as due to the various separations and re-combinations of the atoms which were considered to be *in continual motion* " (Druce, *loc. cit.*, p. 11).

At the present day we recognise attraction and repulsion in physical (and chemical) phenomena but freed from the psychical conceptions love and enmity, hence as purely material. If, however, we would also carry over these conceptions to single material particles, then we lack a mechanical explanation for this and we are directed back to the psychical view. This view signifies, however, an additional hypothesis, and we wish to avoid that.

We have already pointed out that to attribute attraction and repulsion to the ultimate, *individual*, material particles would signify a generalisation which logic in *no* way demands. It is, on the contrary, more acceptable to seek these properties first in combinations of seveal particles or in complex configurations of motion. The guiding thought : that several properties *come into being with the larger associations* of matter : is, unless my memory plays me false, to be found in Bacon, Novum Organum. As a result of this, in order to arrive at the *least hypothetical* explanation of material properties and phenomena, we assume that the smallest, *individual*, material particles neither attract one another nor repel one another.

But in our last discussion, in order to explain cosmic (Millikan) rays, quite along the course of our general line of thought, we no longer took the *proton* to be a *simple* unit but a *complex* unit . . . *viz.*, a cyclone or whirlpool of ether-particles. With this change from simple into complex, a new property can, however, occur . . . the proton as an ether-whirl can exercise an attractive or suctional force. This attraction is thus in this case of a purely *mechanical* kind, the *psychical* epithet " love " cannot be applied to it and also the concept of *force*, which herewith makes its appearance, remains quite within the definition which we gave for it elsewhere : " force, a fictitious imaginative means to calculate effects of motion." (*Chem. News*, July 12, 1929). The effect of an attractive or suctional force of the proton is caused namely by collisions of the moving particles.

It is obvious that the conception of the proton as a complex unit will bring with it clarity on other points and not merely furnish an explanation of the cosmic rays, but the most important point in this case is that we now see a force appear between our atomic constituents and that it need not in any respect be called psychic (except for the part which our understanding has in defining our conceptions) and is yet mechanically completely understandable.

Bergen op Zoom,
Holland.
September, 1929.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

A Dilatometric Study of Some Univariant Two-Phase Reactions. By PIERRE A. CHEVENARD, ALBERT M. PORTEVIN AND XAVIER F. WACHE.

(Abstract of paper read before the Dusseldorf Conference, September, 1929.)

SYNOPSIS.

The authors have investigated, by means of a dilatometer, the reactions taking place in quenched aluminium-copper and aluminium-silicon alloys, when annealed at various temperatures.

The laws of precipitation during constant temperature annealing, and the influence of temperature on the speed of precipitation have been studied.

A hitherto unknown reaction has been found and partially elucidated.

Alloys of iron, nickel, and copper have also been investigated by means of the dilatometer, and the baundary of the two-phase field on the iron side of the system has been determined.

In his Presidential Address at the Spring Meeting of 1928, Dr. Rosenhain emphasised the importance of the dilatometric method for the study of thermal transformations in alloys. He was good enough at the same time—and the present authors are happy to thank him for it—to draw attention to the work of one of them in designing such apparatus and instituting a sensitive experimental method which is both accurate and easy to use. On various occasions the authors have discussed the principles of dilatometric analysis and described some of the results which it has enabled them to obtain. They have also pointed out the reasons for its superiority over other methods of thermal analysis. In order to spare the reader the need for bibliographic researches, they will summarise these reasons. As in the other methods of physico-thermal analysis which are based on the registration of a property of the alloy as a function of temperature, the dilatometric method possesses a definite advantage over the strictly so-called thermal methods; the sensitivity of its indications does not depend on the speed of heating and cooling. One can, therefore, study *very fast* or *very slow* transformations, and even isothermal reactions such as those which take place in the structural quenching of light alloys. One could also analyse weak reactions which are spread over a large range of temperature, as are *univariant two-phase reactions*. In similar cases purely thermal methods have not sufficient sensitivity.

Compared with other physical methods of analysis which are based on recording electrica lproperties, magnetism, elasticity, etc., the dilatometric method has the advantage of being particularly simple to operate, is convenient, and is accurate.

The sensitivity is almost limitless, so great are the resources of metrology for measuring small changes of length. The forces which operate in the phenomena of dilatation are considerable; this enables one to use simple robust apparatus which gives almost instantaneous readings. This also gives rise to curves which are sharp, vigorous, free from accidental curvings, and which are, therefore, very clear.

The results of dilatometric analyses are almost always *easy to interpret*. As a matter of fact, the dilatation of an aggregate almost obeys a mixture law, whereas the physical, magnetic, etc., properties follow a more complicated law. One finds, therefore, on the dilatation curve of an aggregate the dilatometric characteristics of each of the constituents with almost *quantitative intensity*; the specific anomalies and the size of the dilatation. This property is of use as a *method of identification, and even of analysis.* In other words, the transformation is shown: (1) when it takes place, by the dilatometric break which is due to it; and (2) after it has taken place, by the modifications of the dilatability of the alloy. We will see in the study of light alloys examples of this *double aspect of dilatometric analyses.*

Finally, the dilatometric analysis is less affected than are the electrical, magnetic, etc., methods, by *secondary actions*, such as small peculiarities of the thermal and mechanical history of the samples, impurities, etc. These secondary actions cannot, therefore, mask the essential phenomena, although the sensitivity of the method always allows one to take up their study.

CONCLUSIONS.

The results described above, though still *incomplete*, *bring forward further proof* of the value of the dilatometric method—an analytical method which is sensitive, sure, and accurate.

One advantage is that it furnishes numerical results which are comparatively easy to interpret. Another, no less important, is that it gives the mean properties of a dilatation specimen, so that they can safely be referred to the chemical analysis, which deals with a certain volume of metal. The small heterogeneities of the alloys cannot

therefore introduce errors because their effects eliminate each other.

1. In the case of light alloys of aluminium the dilatometric method has succeeded, so the authors believe, for the first time, in explaining *directly* the reactions of solution and precipitation.

The expression for the laws of precipitation, as a function of time, during constant temperature annealing, has been given, and the influence of temperature on the speed of this precipitation has been defined—starting from a supersaturated solid solution.

Although the problem of the unknown reaction in the aluminium-copper alloys is not yet solved, the preceding researches have, at any rate, demonstrated the insufficiency of the classical theory of structural quenching. They have also shown that silicon plays a part in these alloys—a part that the authors are now investigating.

2. In the study of the iron-nickel-copper alloys the authors have shown, in a very clear manner, the physico-thermal reaction which takes place in the two-phase alloys and which is superimposed on the ordinary transformation occurring in ferro-nickels. The phenomena of this reaction have been studied—temperature, hysteresis, etc.—and the authors have obtained a quantitative expression of its intensity.

Finally, the authors have traced the boundary of the two-phase field in the triangular diagram of the γ-iron-nickel-copper alloys.

An Improved Differential-Dilatometer.

By Max Haas, Dr.-Ing., and Denzo Uno, Dr.-Ing.

(*Abstract of paper read before the Dusseldorf Conference, September,* 1929.)

Synopsis.

The accuracy of Chevenard's optical differential-dilatometer has been improved by mounting the apparatus on a triangular rail, by using one dilatometer tube instead of two, and by replacing the spring that holds the mirror by a magnet coil arrangement. Provision is also made for working in any special atmosphere, and for sketching purposes.

The dilatometric method of investigation has aroused much attention during the last few years. Improvements on the so-called "classical methods" have resulted in new information being obtained in the scientific examination of the non-ferrous metals and their alloys. At the same time improvements were naturally made in the apparatus itself.

The present work relates to mechanical improvements in the optical differential-dilatometer of Chevenard, which have been developed during many years of research at the Institut für Metallhüttenkunde der Technischen Hochschule, Aachen.

The Underlying Principle of the Optical and Differential-Dilatometer of Chevenard Remains Unaltered.

The alterations made concern :

(1) A construction which eliminates vibration, and the general disposition of the apparatus.

(2) A suitable type of furnace.

(3) A different form of dilatometer tubes.

(4) A new dilatometer head.

(5) The projection screen.

(6) Standardisation of test-pieces and registration cards.

In the design adopted by H. Esser, the aim had been to produce a universal dilatometer in which, with the aid of accessories, conductivity and magnetic measurements could be made; the present authors have intentionally abandoned this universal purpose and confine themselves to differential thermal expansion measurements.

H. Esser had insulated the dilatometer casing from vibration by oil-damping. The furnace with its casing was placed at right angles to the axis of the camera.

The authors adopt the well-known method of vibration-free mounting as used for metallurgical microscopes, for use with the differential-dilatometer.

The furnace, the dilatometer casing, the camera, and the projection screen are all mounted in the same axis on the triangular rails of the vibration-free suspension.

The underlying principle of a suitable furnace has already been described in a paper on "The Dilatometric Study of Light Metals." The rigid co-axial mounting makes it possible to close both ends of the heated space of the furnace, thus minimising heat losses from the ends. For continuous work on a series of specimens it is desirable to use two furnaces alternatively.

The authors began by using a tube of transparent silica closed at one end, and in this they cut a semi-cylindrical opening to allow of the insertion of the specimen.

The projection screen is placed in the axis of the apparatus beyond the camera; thus, when the dark slide is removed from the camera the spot of light falls on the screen and its position can then be easily adjusted. The screen itself consists of ground glass with a sheet of clear glass in front of it. It is easy to place a piece of photographic paper between the two sheets of glass and

to change this paper when required.

In order to standardise the dilatometer curves, the authors proposed the use of a fixed length, shape, and cross-section for the test-pieces, a standard material for comparison purposes, and a fixed distance for enlargement.

CONCLUSIONS.

The following alterations are recommended in the optical differential-dilatometer of Chevenard :

1. Like the metallurgical microscope, the differential-dilatometer is constructed so as to be free from vibration, on a triangular rail, the whole apparatus having a common axis.

2. One suitably shaped tube, open at one end, is now used instead of the two separate dilatometer tubes.

3. When it is desired to work with any special atmosphere, gas can be led into the closed furnace space.

4. The spring for holding the mirror is replaced by a magnet coil arrangement.

5. A special projection screen is placed behind the camera for use with sensitive paper, and also for sketching purposes.

The authors thank Professor P. Röntgen for his support at the Institut für Metallhüttenkunde, and Messrs. Dujardin for carrying out their ideas in the construction of the apparatus.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Water Content of Inorganic Compounds. I. Water Content of Acid Clay of Koto. By MINORU NAKAMOTO AND GYONEN SANO.

Sinomenine and Disinomenine. XII. Sinomenine Hydrate. By KAKUJI GOTO AND HIDEO SUZUKI.

Constituent of Matteuccia orientalis, Hook. By SHIN-ICHIRO FUJISE.

Mechanism of the Condensation of Glycine Anhydride with Aldehydes. By EINOSUKE UEDA.

Normal Electrode of Calcium. By EI-ICHI SHIBATA.

Thermodynamical Study of Chemical Change. V. Thermodynamical Study of Sodium Hydroxide. By EI-ICHI SHIBATA.

A synthesis of sucrose (cane sugar) has been effected by G. Zemplen and A. Gerecs, Berichte, vol. LXII, p. 984.

NOTICES OF BOOKS.

Das Fermentproblem. By PROF. ANDOR FODOR. Second enlarged edition, pp. xii + 284. Dresden and Leipzig : Theodor Steinkopff. 1929. Price 20 marks.

In this volume on the phenomena of ferments and fermentation processes, which has quickly reached a second enlarged and revised edition, Prof. Fodor has squeezed the main facts concerning the isolation and working of these biochemical agents, especially in connection with their use in organic synthetic work.

He begins by tracing the history of the subject of fermentation from van Helmont's observations down to the latest developments in connection with the phenomena associated with living cells. Then there follows an account of the numerous hydrolytic ferments, which leads to an account of plant assimilation and dissimilation and especially animal metabolism in so far as it is concerned with ferment and enzyme action.

The work concludes with an important section on the connection between ferment action and colloid chemistry, especially in its connection with living matter.

This important volume, like Prof. Fodor's *Grundlagen der Dispersoidchemie* (Steinkopff) is well worthy of the careful scrutiny of organic, physical and bio-chemists. It is dedicated to Prof. Emil Abderhalden.

Sparking of Steel. Facts which everybody using Steel should know and use. By E. PITOIS, Graduate of Ecole Polytechnique, Chief Inspector of the Construction Section of the Governmental Air Service. Illustrated with 82 reproductions of the author's photographs, presenting a complete practical series of spark streams. Preface by General Hirschauer, former Chief of Military Aviation, Former Commander of the Second Army, Chairman of the Aviation Committee of the Senate. Translated from the French and enlarged by John D. Gat, Research Metallurgist, American Sheet and Tin Plate Company. Pp. xii + 89; 82 illustrations. Price $2, post paid. The Chemical Publishing Company, Easton, Pa., U.S.A.

Physiological Chemistry. By RUSSELL C. ERB, B.S., M.S., Professor of Chemistry at the Philadelphia College of Osteopathy, Member of Staff of Osteopathic Hospital of Philadelphia, Abstractor American Chemical Society. Pp. xi + 402, illustrated. Price $4.50 post paid. The Chemical Publishing Company, Easton, Pa., U.S.A.

Chemists' Pocket Manual. (4th Edition.) A practical handbook containing tables, formulæ, calculations, information, physical and analytical methods for the use of chemists, chemical engineers, assayers, metallurgists, manufacturers and students. By RICHARD K. MEADE, M.S., Chemical and Industrial Engineer. The book contains *533 pages, illustrated. Price $5, post paid.* The Chemical Publishing Company, Easton, Pa., U.S.A.

Chemical Bibliographies.

The National Research Council announces the publication of its Bulletin No. 71 which is the First Supplement to the Bibliography of Bibliographies on Chemistry and Chemical Technology covering principally the period 1924-1928, Bulletin No. 50 having covered the period 1900-1924. This Supplement contains approximately 41,00 bibliographies classified under 1,050 headings. The original Bulletin (No. 50) contained approximately 10,000 bibliographies classified under 2,400 headings.

As the title indicates, the work (as in the case of Bulletin No. 50) is a compilation of bibliographies published as separates, or at the end of books or magazine articles, or as footnotes to the same, on the numerous aspects of pure and applied chemistry. Each entry gives name of author or compiler, title, and place of publication. The majority of the entries state the number of references, thus giving an indication of the completeness of the particular bibliography. The entries are classified under the proper subject-headings, alphabetically arranged. The duplication of individual entries has been largely avoided by the liberal use of cross references.

As an example of the value of this compilation, the following information is given regarding the number of bibliographies reported in Bulletin 71 for some of the more important topics :

Blood chemistry 25, Cement 21, Coal 81, Colloids 55, Dielectrics 24, Dyes and Dyeing 27, Fertilisers 38, Fibres 26, Foods 88, Iron and Steel 76, Metabolism 77, Milk 43, Mineral Resources 25, Paper 39, Petroleum 54, Photography 86, Plant Chemistry 41, Rubber 55, Vitamins 25, Water 45.

Copies of Bulletin No. 71 may be obtained from the publication office, National Research Council, B and 21st Streets, N.W., Washington, D.C., for $1.50 a copy. Also copies of the previous Bulletin (No. 50) may be obtained from the same source for $2.50 each.

DEATH OF LADY BRAGG, WIFE OF SIR WILLIAM BRAGG.

We regret to record the death of Lady Bragg, who assiduously helped her eminent husband in his divers scientific activities. *The Times* of 1 inst., contains the following handsome tribute by Sir Arthur Keith :—

" Members of the Royal Institution will receive the intimation of Lady Bragg's death on Sunday with profound regret. Since 1923, when Sir William Bragg succeeded the late Sir James Dewar as director of the Institution, Lady Bragg devoted herself to its social and scientific welfare, and more than maintained the high traditions of hospitality which have been a feature of the Institution since its inception well over a century ago. With a deep understanding of the ways and aims of scientific men and a heart which was warm, sympathetic, and open, she made an ideal hostess at the gatherings which follow the celebrated evening discourses of the Institution. She was the heart and soul of a wide circle, and easily accessible to all, rich and poor. Many a young scientific worker has been encouraged by her sympathetic understanding and strengthened by her wise counsels. She was ever ready to share in any good or charitable work, both inside and outside the Institution, and much of the success which has attended the directorate of Sir William Bragg is due to her ever-ready help.

"Lady Bragg was born in South Australia, being the daughter of one of the leading men of that Colony, the late Sir Charles Todd. In 1889—40 years ago—she became, at the age of 20, the wife of William Bragg, the young professor of physics in the University of Adelaide, thus entering an ideal partnership. In 1908 her husband was appointed to the Chair of Physics in the University of Leeds, and later to the Quain Chair of Physics in University College, London. Thus Lady Bragg had a wide and varied experience of university life, and never failed to make herself an intrinsic and *helpful element of that life.* When the British Association men in Glasgow under the presidency of Sir William Bragg only a year ago, Lady Bragg threw herself into the social organisation of the meeting, and helped greatly in the success of the meeting. She had gifts as an artist, but her genius lay in knowing how to sacrifice herself for the good of others. The sympathy of a wide circle goes out to Sir William Bragg in his bereavement."

Forthcoming Events.

THE PHYSICAL SOCIETY.

PROGRAMME FOR 1929-1930.

The meetings of the physical Society will be held, unless otherwise announced, at the Imperial College of Science, Imperial Institute Road, South Kensington, on the dates given below (usually the second and fourth Fridays in the month) at 5 p.m. :—

1929. — October 25, November 8, 22, December 13.

1930 — January 7, 8, and 9, Annual Exhibition, (Afternoon and Evening); January 24, February 14, 28, March 14, 28, Annual General Meeting; April 11, May 9, 23, June 13, 27.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

A Course of Lectures on "Problems of Personal and Public Health," will be delivered in the Lecture Hall, 37, Russell Square, London, W.C.1., every Wednesday, commencing on October 16, and ending on December 18. The arrangements for October are given below :—

Wednesday, October 16, at 4 p.m.—"The Health and Conditions of Work of Medical Students." By E. Graham Little, M.D., F.R.C.P., M.P., Physician in charge of the Skin Department, St. Mary's Hospital. Chairman : The Lord Moyniham, K.C.M.G., C.B., F.R.C.S,, President of the Royal College of Surgeons of England.

October 23, at 4 p.m.—"Broadcasting and Health." (With lantern illustrations.) By J. C. Stobart, M.A., Education Director to the British Broadcasting Corporation. Formerly H.M. Inspector of Schools. Chairman : Lt.-Col. F. E. Fremantle, O.B.E., M.D., F.R.C.P., D.L., M.P., Consulting Medical Officer of Health, Herts County Council.

October 30, at 4 p.m.—"The Asthma Problem." By Arthur F. Hurst, M.D., F.R.C.P., Chairman, Medical Advisory Committee, Asthma Research Council; Senior Physician to Guy's Hospital. Chairman : Ben Tillett, M.P., Secretary, Political and International Department of the Transport and General Workers' Union.

THE INSTITUTE OF METALS.

WINTER SESSION ACTIVITIES.

The Institute of Metals has just issued its programme for the coming Session. This includes over 40 Meetings to be held in metallurgical centres throughout England, Scotland and Wales. The programmes of the various local sections have been drawn up to meet the needs of local industries. The subjects dealt with are of an essentially practical character, and include papers on "Metals in Aircraft Construction"; "Metal Melting by Electricity"; Chromium Plating"; "Some Difficulties in Aluminium Alloy Founding and Some Remedies"; "Electric Heat-treatment Furnaces"; and "'The Effect of Some Impurities in Copper." Copies of the programmes can be obtained on Application to the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Mr. F. E. Smith, C.B., C.B.E., D.Sc., F.R.S., Director of Scientific Research at the Admiralty, has been appointed by His Majesty the King in Council to be Secretary to the Committee of the Privy Council for Scientific and Industrial Research, with effect from the 1 October, 1929, on the resignation of Mr. H. T. Tizard, C.B., F.R.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Application.

27,860.—Asseev, C. d'. — Simultantously preparing aluminium oxide and carbonic acid. September 13.

27,621.—Bataafsche Petroleum Mattschappij.—Treatment of acid tars of resins. September 11.

27,903.—Beckett, E. G., and Scottish Dyes, Ltd., and Thomas, J.—Production of aluminium chloride. September 13.

27,642.—Hough, A.—Method of nitrating organic substances. September 11.

27,527.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of naphthalene-2 :3-dicarboxylic acid. September 10.

Specifications Published.

290,657.—Oka, K.—Process of purifying sodium glutamate.

303,742.—Soc. Anon. des Distilleries des Deux - Sevres. — Dehydration of aqueous formic acid.

Abstract Published.

816,284.—Acetic Acid. — Distilleries des Deux-Sevres, Melle, Deux-Sevres, France.

Pyroligneous acid is freed from impurities such as tars by treatment with suitable solvents of the impurities, so that the purified acid can be subsequently extracted with acetic acid solvents. The preferred solvents for the tars, etc., are the homologues of cresol such as the ethyl, propyl, butyl, and amyl cresols. Preferably the cresol homologues are mixed with a hydrocarbon which, in the subsequent recovery of the solvent by distillation forms an azeotropic mixture with the small quantity of dissolved acetic acid so that this acid is recovered. In an example a pyroligneous acid containing 10 per cent. of acetic acid and 5 per cent. of tars is treated continuously with one-fifth of its volume of butyl cresol obtained by treating with zinc chloride a mixture of butyl alcohol and cresol.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ERA-SOL.

502,470.—A chemical substance for use in the discharging and printing of textile and similar materials.—L. B. Holliday & Co., Limited, The Chemical Works, Leeds Road, Deighton, Huddersfield. September 4.

INSPRO.

504,347.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—Cecil Thomas Lewis, Artuhr George Falkner, and John William Battersby, trading in co-partnership, 16-17, Devonshire Square, London, E.C.3. September 11th.

LANYORK.

505,169.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. — The Springhead Varnish Co., Limited, Springhead Old Mill, Oldham Road, Springhead. September 11.

NIKOPREN.

505,302.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. September 11th.

INSPRO.

504,348.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Cecil Thomas Lewis, Arthur George Falkner, and John William Battersby, trading in co-partnership, 16-17, Devonshire Square, London, E.C.3. September 11.

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

WANTED, *Chemical News*, January 6, 1928.—G. E. Stichart & Co., 2, Star Yard, Carey Street, London, W.C.2.

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BRITISH PATENT.

It is desired to secure the full Commercial Development in the United Kingdom of British Patent No. 158,852, which relates to "Distillation of Tar," either by way of Sale or the grant of Licences on reasonable terms.

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POLAROGRAPHIC STUDIES WITH THE DROPPING MERCURY CATHODE. THE DEPOSITION OF ZINC FROM CYANIDE SOLUTIONS.

By I. PINES.

(*Continued from page 212.*)

Calculation of the Complexity Constants : The complexes of zinc and cyanide to be considered are $Zn(CN)_3'$, $Zn(CN)_4''$, $Zn(CN)_5'''$. None of the waves may be regarded as connected with the concentration of undissociated molecules $Zn(CN)_2$, for two reasons : (1) since in cyanide solutions saturated by solid zinc cyanide the height of all three waves changes according to the cyanide concentration, whereas the concentration of undissociated molecules, $[Zn(CN)_2]$, should be constant in presence of the solid phase; (2) owing to the slight solubility of zinc cyanide (of the order of 10^{-4} n), this compound has to be regarded as practically dissociated, so that the concentration $[Zn(CN)_2]$ is negligible in comparison with the concentrations of zinc ions. From this point of view let us consider ionic equilibrium states in potassium cyanide solutions of varying concentration always saturated with solid zinc cyanide. Then for the general reaction

$$Zn^{\cdot\cdot}+x.CN'\longrightarrow Zn(CN)_n^{(x-2)} \qquad (1)$$

the mass action constant is

$$\frac{[Zn^{\cdot\cdot}].[CN']^x}{[Zn(CN)_n^{(x-2)'}]}=K \qquad (2)$$

and the solubility product

$$[Zn^{\cdot\cdot}].[CN']^2=K_1 \qquad (3)$$

From (2) and (3) follows

$$\frac{\sqrt{K_1^x}}{[Zn(CN)_x^{(x-2)'}].\sqrt{[Zn^{\cdot\cdot}]^{x-2}}}=K \qquad (4)$$

or

$$[Zn(CN)_x^{x-2'}].\sqrt{[Zn^{\cdot\cdot}]^{x-2}}=K' \qquad (5)$$

The concentration of free zinc ions, $[Zn^{\cdot\cdot}]$, is proportional to the first wave; the concentration of particles $Zn(CN)_x^{(x-2)'}$ is in our supposition proportional to the second and third wave, according to the values of x. If for the second wave x were equal to three, the relation between the heights of the first and second wave should be, according to (5) :

$$[Zn(CN)_3'].\sqrt{[Zn^{\cdot\cdot}]}=K' \qquad (6)$$

If, however, at the second wave zinc from the complex with $x=4$ is deposited, then

$$[Zn(CN)_4''].[Zn^{\cdot\cdot}]=K'_2 \qquad (7)$$

which means that whatever be the concentration of the alkali cyanide, as long as the

solution is saturated with zinc cyanide, the *product of heights of the first and second* wave should be constant. To decide between the relation (6) and (7) solutions saturated with thoroughly washed zinc cyanide, were prepared and examined polarographically; the results are given in the following table :

normal concentration of *KCN*		*a* height of the first wave cm		*b* height of the second wave cm		*a.b*		$b.\sqrt{a}$
10^{-4}	...	1.6	...	0.9	...	1.35	...	1.08
4×10^{-4}	...	1.5	...	0.8	...	1.28	...	1.04
10^{-3}	...	1.0	...	1.6	...	1.6	...	1.6
4×10^{-3}	...	0.6	...	3.0	...	1.8	...	2.4
10^{-2}	..	0.4	...	4.8	...	1.92	...	2.88
1.8×10^{-2}	...	0.2	...	7.5	...	1.5	...	3.0

We observe that the simple product $a.b$, of the heights of the waves (according to (6)) *is much closer to a constant than the* product $\sqrt{a}.b$, and conclude that the second wave is due to the deposition of zinc from the complex $Zn(CN)_4''$.

For the complex decomposing at the third wave we have to try $x=5$ and $x=6$, which leads to formulæ

$$[Zn(CN)_5'''].[Zn^{\cdot\cdot}]^{\frac{3}{2}}=K' \quad (8)$$

and

$$[Zn(CN)_6''''].[Zn^{\cdot\cdot}]^2=K' \quad (9)$$

In this respect following solutions were investigated with the results given :

normal concentration of *KCN*		*a* height of the first wave cm		*c* height of the third wave cm		$a^{\frac{3}{2}}.c$		$a^2.c$
10^{-4}	...	1.6	...	1.2	...	2.43	...	3.07
4×10^{-4}	...	1.5	...	1.5	...	2.85	...	3.37
10^{-3}	...	1.0	...	2.9	...	2.90	...	2.90
4×10^{-3}	...	0.6	...	5.5	...	2.64	...	1.98

Formula (8), $a^{\frac{3}{2}}.c$, holds evidently better than formula (9), which shows that the complex decomposing at the third wave is $Zn(CN)_5'''$.

There must be, however, a still higher complex formed, probably $Zn(CN)_6''''$, into which the lower complexes are transformed on further increase of the cyanide concentration and which does not decompose up to the deposition potential potential of -2.0 v.

To enumerate the constants of formulæ (7) and (8) the solubility product of the zinc cyanide (3), has to be determined. For this purpose zinc cyanide was precipitated and many times washed. It was found that when excess of potassium cyanide was used for precipitation the polarogram of the suspension of this zinc cyanide exhibited always the three waves, the heights being : $a=1.9$ cm, $b=0.7$, $c=1.0$; thus $ab=1.33$ and $a^{\frac{3}{2}}.b=2.66$ as in the solutions given above. This indicates that in the solution of zinc cyanide autocomplexes are formed according to the scheme :

$$Zn(CN)_2 \rightleftarrows Zn^{\cdot\cdot}+2CN'$$
$$2CN'+Zn(CN)_2 \longrightarrow Zn(CN)_4''$$
$$CN'+Zn(CN)_4'' \longrightarrow Zn(CN)_5'''.$$

When, however, zinc cyanide precipitated without excess of potassium cyanide was used, the polarogram of the solution showed only the first zinc wave, 2 cms high. The latter polarograms were obtained with $\frac{1}{4}$ sensitivity; it was ascertained that with this sensitivity a 10^{-4} molar chloride solution gives a wave 5 cms high. Thus the solution saturated with pure zinc cyanide contains zinc ions 0.4×10^{-4} gram-ions of zinc per litre; the concentration of cyanide ions is thus 0.8 gram ions per litre.

Hence the solubility product of zinc cyanide, expressed in gram-ions per litre, is $2.56 \times 10^{-13}=K_1$.

Considering that a wave 1 cm high represents (with $\frac{1}{4}$ sensitivity) a concentration about $0.2.10^{-4}$ *gram-ions per litre, we may*

determine the concentrations of zinc ions in solutions as

$$[Zn^{\cdot\cdot}] = a \times 0.2.10^{-4}$$
$$[Zn(CN)_4{''}] = b \times 0.2.10^{-4}$$
$$[Zn(CN)_5{'''}] = c \times 0.2.10^{-4}$$

Then

$$[Zn(CN)_4{''}].[Zn^{\cdot\cdot}] = ab \times 0.4.10^{-9};$$

the mean value of ab is 1.54; thus

$$[Zn(CN)_4{''}].[Zn^{\cdot\cdot}] = 0.62 \times 10^{-9}.$$

Substituting into formula (4) we obtain

$$\frac{K_1{}^2}{[Zn(CN)_4{''}].[Zn^{\cdot\cdot}]} = \frac{[Zn^{\cdot\cdot}].[CN']^4}{[Zn(CN)_4{''}]} = \frac{(2.56.10^{-13})^2}{0.62.10^{-9}} = 1.06.10^{-16} = K_2.$$

Similarly, for the complex $Zn(CN)_5{'''}$, since $a_{\frac{1}{2}}.c$ has the mean value 2.7, the constant is obtained:

$$\frac{\sqrt{K_1{}^5}}{[Zn(CN)_5{'''}].\sqrt{[Zn^{\cdot\cdot}]^3}} = \frac{[Zn^{\cdot\cdot}].[CN']^5}{[Zn(CN)_5{'''}]} = \frac{(2.56.10^{-13})^{\frac{5}{2}}}{2.7 \times 1.8.10^{-12}} = 6.81.10^{-21} = K_3.$$

Other electro-chemical evidence bearing on the results here obtained:

At the dropping mercury cathode an instance of a reduction of one substance at two potentials is described by M. Shikata[4], who obtained two reduction potentials of pyridine; at one pyridine is reduced from the ionic state, at another from molecules.

The complexes of zinc from which it deposits at different potentials thus behave as if they were alone in solution each kind uninfluenced by the presence of the other.

We have, however, assumed, that after a time they come slowly into an equilibrium state with free zinc ions. If zinc is deposited reversibly from these complexes, it is a thermodynamic necessity that all should decompose at the first deposition potential, unless the end-product, *i.e.*, atomic zinc, deposited from various complexes, is in different states of free energy. Since the polarograms obtained in this research exhibit the same character in the turnings of the ascending part of the curves as any other reversible kind of deposition studied before (*e.g.* that from cadmium from simple or complex salts), the view has to be adopted, that zinc atoms deposited from complexes are in a super-active condition. According to the suggestion of Prof. J. Heyrovsky this condition might be due to "excited atoms" with electrons in abnormal conditions, which, after deposition turn into the normal state of metallic zinc, with the normal deposition potential.

In electro-deposition of zinc it is indeed found that zinc deposited from simple salt forms coatings of different structure and resistance than when deposited from an alkali cyanide solution saturated with zinc salt.[5]

This ordinary electro-deposition of zinc, which takes place only from solutions with no excess of the alkali cyanide, is in agreement with the experience from the dropping mercury cathode. This is best seen from the investigations of F. Spitzer,[6] who studied the electrolysis of solutions of complex cyanides of zinc and of copper and found that the efficiency of the metallic deposition diminishes with the increase of the alkali cyanide concentration. Spitzer's curves indeed show roughly increases of current at voltages, at which the polarographic analysis reveals the three waves.

Another characteristic phenomenon observed by Spitzer in electrolysis of zinc and copper cyanide solutions is that the deposition potentials of these metals are considerably more negative than the electrode potentials these metals acquire when dipping into the respective cyanide solutions and that no calculations of equilibrium constants from such concentration cells may be derived. This again is easily understood from our observations that there are several complexes present, moreover in a slowly established equilibrium state.

Similar results to those of Spitzer are described by A. Höing[7] and F. Förster,[8] who point to another important phenomenon exhibited by this group of complex cyanides, *viz.*, the behaviour in electrolysis with alternating current.

The fundamental observations here are those of M. Le Blanc and K. Schick,[9] who found that alternating current electrolysis does not bring silver or cadmium into a solution of their complex cyanides, however, that it dissolves copper and zinc electrodes. Förster does not seek the hindrance of the zinc deposition in the high complexity of the zinc-cyanide ions, but regards it to be due to the slow rate of dissociation. According to him the cyanides of copper and zinc are no more complex than those of silver or cadmium, however are formed and decomposed more slowly. Our investigations confirm this view, showing that the complexity con-

stants are of the order of those of the cadmium complex and proving that the equilibrium between free and complex ions establishes slowly, since several deposition potentials are obtainable.

The same view-point furnishes the work of A. Brochet and F. Petit,[10] who according to their investigations on alternating current electrolysis of complex cyanide solutions divide the metals into the three groups, as described in the previous communication. They again show that not great complexity but slowness of reaction hinders zinc and copper to deposit.

INFLUENCE OF TEMPERATURE AND OF HYDROGEN EVOLUTION.

Förster points out the temperature influence to be in favour of the slow reaction velocity theory : owing to the increased rate of dissociation of the cyanide complex at elevated temperatures, the deposition of zinc and copper is facilitated. In view of the difficulties in the adaptation of the dropping mercury cathode method for high temperatures, experiments were not yet carried out at other than room temperatures, although the importance of such investigations for the present research is fully recognised.

The fact that increase of temperature increases the efficiency of zinc deposition allows to decide that it is not the high complexity of the zinc-cyanide anion but the slowness of its decomposition and consequent hydrogen evolution, which lowers the efficiency in ordinary electrolysis. Owing to the rapid decrease of hydrogen overvoltage with increasing temperature, evolution of hydrogen would still more diminish the efficiency, should the deposition potential of zinc be more negative than that of hydrogen. Thus the view is confirmed that the deposition potential of zinc from cyanide solutions is less negative than that of hydrogen and that only the slowness of the dissociation allows the hydrogen to evolve simultaneously.

At the dropping mercury cathode, however, hydrogen evolution never interferes, and thus the cause of the hampering effect in zinc deposition cannot be sought in the position of the potential of hydrion deposition. It may be reminded here that the role of hydrogen evolution has to be equally eliminated in the explanation of the hindrance of copper deposition from copper-cyanide solutions, which is discussed in the recent communication of S. Glasstone[11]; the polarograms obtained by N. Demassieux and J. Heyrovsky[12] from solutions of copper cyanides show that by increasing the concentration of the alkali cyanide the current due to deposition of copper decreases until it disappears and merely the alkali metal is deposited, but nowhere the deposition of hydrogen ions interferes.

The author wishes to express his best thanks to Professor J. Heyrovsky, at whose suggestion and under whose guidance this investigation has been carried out.

SUMMARY.

1. Zinc deposits from solutions of potassium and zinc cyanides at the dropping mercury cathode as long as the cyanide content does not exceed 4 $KCN : Zn(CN)_2$; with a greater excess of the alkali cyanide only potassium is deposited.

2. From solutions with no, or a small excess of the alkali cyanide, zinc deposits at three distinctly different potentials, at -1.03 v. from simple $Zn^{\cdot\cdot}$ ions, at -1.23 v. from anions $Zn(CN)_4''$, and at ca -1.4 v. from anions $Zn(CN)_5'''$; the anions $Zn(CN)_6''''$ assumed to be formed in excess of the alkali cyanide, are not decomposed below the deposition potential of potassium.

3. The complex anions, which are supposed to come slowly into equilibrium with free zinc and cyanide ions, have constants

$$\frac{[Zn^{\cdot\cdot}].[CN']^4}{[Zn(CN)_4'']} = 10^{-16},$$

$$\frac{[Zn^{\cdot\cdot}].[CN']^5}{[Zn(CN)_5''']} = 6.8 \times 10^{-21};$$

the solubility product

$$[Zn^{\cdot\cdot}].[CN']^2 = 2.6 \times 10^{-13}.$$

4. Evidence is adduced from ordinary and alternating current electrolysis and this work that not the great complexity but the slowness of dissociation of the complexes hinders the deposition of zinc from potassium-zinc-cyanide solutions.

LITERATURE.

1 J. Heyrovsky-B.Soucek : *Compt. rend.*, 1926, CLXXXIII, 125.

2 B. Gosman : *Rec. trav. chim.*, 1925, XLVI, 600.

3 G. Bodländer : *Z. Elektrochem.*, 1904, X, 604; and W. Eberlein : *Z. anorg, Chem*, 1904, XXXIX, 197, and Storbeck, *ibid*, 1902, XXXI, 458; and R. Fittig, *Z. physikal. Chem.*, 1902, XXXIX, 597.

4 M. Shikata : *Mem. Coll. Sci.*, Kyoto, 1927, No. 4, 717.

5 F. Beilstein and Fr. Jawein : *Ber.*, 1879, XII, 446; C. Luckow : *Z. anal. Chem.*, 1880, XIX, 17.

[6] F. Spitzer : Z. *Elektrochem.*, 1905, XI, 345.
[7] A. Höing : *ibid*, 1916, XXII, 286.
[8] F. Förster : *ibid*, 1907, XIII, 561.
[9] M. Le Blanc : *ibid*, 1905, XI, 8, 705; and K. Schick : *ibid*, 1903, IX, 636; Z. *physikal. Chem.*, 1903, XLVI, 213.
[10] A. Brochet and F. Petit : Z. *Elektrochem.*, 1904, x, 909.
[11] S. Glasstone : *J. Chem. Soc.*, 1929, 702.
[12] N. Demassieux and J. Heyrovsky : *Bull. Soc. chim.*, 1929, XLV, 30.

The Physico-Chemical Institute of
the Charles University, Prague.

—From the *Collection of Czechoslovak Chemical Communications.*

THE TEACHING OF SCIENCE.

With every extension of educational facilities from the latter half of last century till the present day increasing attention has necessarily been given to the further dissemination of scientific knowledge. To-day Science, in some fashion at least, is included in almost all educational curricula from the primary schools to the universities. The most important part of the teaching of science in this country is undertaken in the secondary schools where it forms an essential part of the general education of every pupil up to the "School Certificate" stage, *i.e.*, to the age of 15 or 16.

Much has been written concerning the teaching of Science in schools dealing, *inter alia*, with the subjects and subject matter, its manner of presentation, the qualifications of the teacher and with numerous other educational aspects connected with the teaching of Science. It is doubtful, however, if there has hitherto appeared so comprehensive an account of the Teaching of Science as the work of Mr. F. W. Westaway whose book (Science Teaching, *What It Was What It Is What It Might Be.* Pp. XXII + 442. London : Blackie & Son, Ltd., 50, Old Bailey, E.C.4., and 17 Stanhope St., Glasgow, C.4. 1929. Price 10s. 6d. net) has just been published.

This important volume represents the conclusions and ripe experience of a former inspector of secondary schools and covers practically every aspect of the subject, particularly from the science master's standpoint. It is divided into four parts which deal, respectively, with the principles of science teaching, the subjects of instruction, extended consideration for sixth forms, and accommodation and equipment.

To the younger generation the account of science teaching in bygone days (from 1867), makes interesting reading although it must not be assumed that there are no longer any difficulties confronting the young graduate on entering the teaching profession. If he is a keen chemist he will wish to continue some research work commenced at College. He is almost certain to incur opposition from his elderly senior or the headmaster, who will assume he is neglecting his teaching work or is "wasting" chemicals or wishes to buy special apparatus for personal use, etc., etc. It is by no means fully realised that by conducting research work the science master is maintaining his manipulative skill and his close contact with the progress of chemistry and in this manner contributing to his success as a teacher of chemistry.

As regards the method of imparting knowledge, the author clearly shows the present tendencies and the success attending modern methods of expounding science to young pubils. He gives a good account of Prof. H. E. Armstrong's "Heuristic" method introduced in the late 'eighties and points out its limitations even when applied in a modified form. Mr. Westaway gives two "model" sets of laboratory exercises ("Air" and "Water") in which the acquiring of actual chemical knowledge is regarded as a secondary objective. The pupils were made to "discover" everything for themselves. Yet one wonders why, with such a wonderful scheme Prof. Armstrong left it to Lord Rayleigh and Sir William Ramsay to discover the inert gases of the atmosphere!

Essentially, the heuristic method is intended to provide a training in scientific *methods*. The method is *formative* rather than informative. Such training, if properly carried out, does cultivate painstaking and observant habits, and encourages intelligent and independent reasoning. It does bring home to boys clear notions of the nature of experimental evidence, and the boys do learn that answers to questions can often be obtained from experiments they can work for themselves.

On the other hand, progress is inordinately slow, even with exceptional teachers. Far too little ground is covered in a term. The work attempted was confined almost entirely to physics and chemistry, and pupils received a wrong idea of science as a whole, or, for that matter, of physics and chemistry as a whole The succession of exercises was rarely planned to fit into a general scheme

for building up a subject completely; bits of a subject are chosen just because they lend themselves best to the particular type of training. Time is wasted over experiment that are beyond the pupils' skill and ought to be performed by the teacher.

Unless the term "discovery" is confined to just the final result that naturally follows from suggestions and leading questions made by the teacher, it had better not be used. A boy never "discovers" a principle, and it is doing him a disservice to let him think he does. Above all things, science teaching demands intellectual honesty. The heuristic method has therefore had to be rejected.

At the same time, no system of science teaching is likely to be effective unless it is animated by a spirit of *search*, whether at the demonstration table or in the laboratory. The pupil ought to see that the work he is engaged in, or that his teacher is engaged in, is a problem, and a problem worth solving, not merely a laboratory "exercise." The teacher should keep the pupil's mind in a state of tension; he should compel the pupil to follow up the details of an experiment, and to piece together the steps which have led up to a definite conclusion.

In dealing with the purpose of science teaching Mr. Westaway points out that there can be no doubt that the science master's real battle is concerned at least as much with the dissemination of knowledge as with the training of the intellect. Those who teach science must cease to look at their several subjects so much from the inside. They must try to appreciate the unity of purpose of the whole range of scientific study, and the impacts of this study upon the common stock of ideas. They must break with the bad tradition of serving up year after year the same twopenny-worth of weighing and measuring—that poor little miniature of a university dish, not even garnished to conceal the beggarly fare it contains. They must broaden the basis of their teaching, particularly by the inclusion of biology. They must extend their pupil's scientific horizon. They must give up the idea that, if they give a lesson on some small topic of science by methods which will win the warm approval of the doctrinaire critic, they are therefore discharging effectively their main function as science masters. The teaching of science is a much bigger thing than the devising of means of giving satisfaction to critics of the minutiæ of laboratory procedure. A laboratory is not a place either for the mechanical repetitions of a cloistered cell or for the dusty ritual of an antiquary's den.

Having a wide knowledge of many sciences himself, he seems to assume, however, that the average science master still teaches two or three subjects, but the tendency now is for one or two men to teach nothing but chemistry and one or two others only physics. The same practice must soon obtain as regards biology, the claims of which to a general inclusion in all modern science work cannot be ignored much longer.

In dealing with the different science subjects, Mr. Westaway devotes a chapter to each of them, namely, Mechanics, Physics, Chemistry, Biology, Botany, Zoology, Human Physiology, Embryology, Heredity, Evolution, Geology and Paleontology, Bacteriology, Hygiene, Astronomy, Domestic Science, Meteorology and Weather Forecasting. In the Extended Considerations for Higher Work the author suggests syllabuses for "The Structure of the Atom," Relativity, The History of Science, Research — Its Significance and Importance, the Philosophical Foundations of Science and Science and Humanism.

It is evidently impossible for anything like all these subjects to be included in a science course, apart from the fact that all classical subjects are omitted altogether.

So far as chemistry is concerned, the importance of keeping in touch with new developments and industrial applications is emphasised. The strictures on certain types of laboratory work are also sometimes deserved and the beginner is warned of a number of "snags" whilst "model" expositions of certain phenomena and their illustration are given. Of the books recommended by the author for careful study, the reviewer confesses that he was not familiar with several. He would, however, have included some that Mr. Westaway does not mention and also ventures to point out that some in the lists given (*e.g.*, Ramsay's excellent volume, *Gases of the Atmosphere*) are out of print.

Upon the questions of accommodation and equipment—matters of vital concern to the conscientious science master — much more could be said than the author indicates but there is now at least a strong tendency on the part of governing bodies towards providing better facilities.

Enough has been said to show that Mr. Westaway's book is of extreme interest to all science masters and will be especially helpful to those at the outset of their careers.

J. G. F. DRUCE.

MASS NUMBERS OF THE CHEMICAL ELEMENTS AND OBSERVATIONS ON ELEMENT FORMATION.—FOURTH NOTE.

By F. H. Loring.

In my last note (3rd) particular attention was drawn to the absence of elements of Groups I and VII in the radioactive series (see page 195 of this Vol.); but the discussion was mainly confined to the alkali elements.

Now Group VII shows a tendency of non-formation in respect of its elements, which may be connected with the scarcity of those of atomic numbers 43, 75, and 61.

If the element classification is arranged in a certain well-known way it shows the element of atomic number 61 as a member of Group VII. This element is of course the one discovered by Hopkins, Harris and Yntema, which they named *illinium*. It is not, however, a proper member of Group VII, as the best classifications reveal, since it belongs more properly to the rare-earth group or series ;but it is no doubt a mistake always to adhere to one type of arrangement, since all types are more or less artificial, and on this account the placing of illinium in Group VII is permissible if only for the purpose of the present argument. Moreover, illinium falls into my *minimum-quantity series* together with the other two elements mentioned above (see *Chemical News*, 1922, *125*, 309).

The other two elements just mentioned, now known as masurium (43) and rhenium (75), fall properly into Group VII, as is well known.

The point to be made here is that the above elements which are of Group VII—with one a partial exception as just mentioned—exist in small relative quantities when compared with their neighbours, so that element formation in Group VII has evidently been very difficult of accomplishment, as is also the case in respect of Group I, according to the previous discussion—see *Chemical News*, 1929, *139*, 1, 108, 139, 195.

Any further number-peculiarity as previously discussed (page 1 of this Vol.) cannot be considered in respect of those elements of Group VII, because their isotopes are not yet known.

It is not suspected that the elements here considered are radioactive like potassium and rubidium, though it might be worth while considering this possibility. In fact it could be argued that any sort of radioactivity that these elements might possess should be the reverse of that of potassium and rubidium; but, assuming, in the case of these two alkali elements that the action is balanced (see page 196), it is not clear how any opposite effect could be possible. It is not wise in this circumstance to build one theory on the top of another, so that the least said the better.

In my *third note*, insert the word *interpretation* after the word "which" in the second line up on page 195; and on the next page insert the word *with* before "incomplete" in the last paragraph. This will make the meaning clear.

GENERAL NOTES.

ONTARIO MINERAL PRODUCTION.

The recent report of the Ontario Department of Mines relative to mineral production during the first half of 1929 gives many indications of greatly increased production during the next few months. In the nickel copper industry, mention is made of the consolidation of the mining, smelting and refining interests of the International and Mond Nickel Companies in the International Nickel Company of Canada, Ltd., and the continuation of the expansion noted in 1928. Due to the development of the Frood mine, with its ore of high copper content, now under one control, notable changes in operation are being made. The two smelters operate as formerly, it is stated, but important additions to the plant at the Copper Cliff Smelter are now under way, comprising new bins, a new concentrator for the Frood ore, new roasters and reverbatory furnaces, also an additional converter building. The smelter chimney, just completed is 510 feet in height, 68 feet 7 inches inside diameter at the base and 45 feet at the top. At the Coniston works a sintering plant is now being built.

In addition to the International operations, the report states that a new producer is about to enter the field in the Falconbridge Mines, situated 14 miles northeast of Sudbury, where a 1,000-foot shaft has been completed and a smelter of 800 tons capacity is under construction. For refining purposes the company has bought the Kristiansands nickel refining works in southern Norway.

Another interesting development in the Sudbury nickel-copper field is that Canadian Industries, Ltd., has taken over the Mond sulphuric acid plant at Coniston and

will construct a 200-ton acid plant at Copper Cliff to make sodium bisulphate (nitre cake) using natural soda from Saskatchewan and sulphuric acid produced from sulphur fumes given off at the Copper Cliff smelter.

Gold.

Interesting developments in the gold fields are dealt with and it is indicated that a number of new producers are coming into operation. The outstanding new development is the 500-ton mill under construction at the Howey mine in the Patricia district, which the Report states is expected to be in operation early in the new year when hydro-electric power will be available from Ear Falls on the English River, under development by the Hydro-Electric Power Commission of Ontario. Other developments are that the St. Anthony mine at Sturgeon Lake and the Cooper at Michipicoten commenced milling, the latter operating a 20-ton pilot mill; the telluride mine in Skead Township has a mill under construction; the Moss Mines has decided to erect a mill on its property west of Port Arthur; and the Bobjo Mines is operating a small plant for treating high-grade ore at Confederation lake in the Patricia district.

The outstanding feature of Ontario's gold output during the latter half of 1928 and the first six months of 1929 was the steady advance in production from the Kirkland Lake area, states the report, adding that the two leading mines, Lake Shore and Teck-Hughes, increased their output sufficiently to offset any reduction from other areas. Average recovery at Kirkland Lake was $13.10 per ton and at Porcupine, $6.49. Porcupine reduction of gold shows some falling off at $9,858,776 for the first six months of 1929 compared with $9,856,261 in the first half of 1928. On the other hand, the Kirkland Lake Camp shows an increase of over $1,000,000 at $7,110,600 compared with $6,079,791 in the January-June period of 1928.

Lead-Zinc.

Yet another development in Ontario metal mining is that a new producer of lead and zinc has appeared, namely the Treadwell-Yukon Company, operating the Errington mine near Sudbury. The report states that it is expected that the production of lead and its complementary metal zinc will increase in future due to developments in the Sudbury field. Zinc in concentrates exported in the first half of 1929 was estimated at 2,003,045 pounds valued at $115,456.

THE SIR JOHN CASS TECHNICAL INSTITUTE.

Inauguration of the Work of the 28th Full Session (1929-30).

Before dealing with the programme of work for the present session, the Chairman of the Governing Body (the Rev. J. F. Marr, M.A.) reviewed the work of the past academic year, and stated that the provision of grouped courses of instruction had been greatly appreciated by those engaged in technical branches of industry and further, that insistence on a good knowledge of fundamental science as an antecedent to specialised or vocational training had led to the most satisfactory results. An extension of advanced and post-graduate work had also been made with considerable success.

A total of 29 students were successful at the London University post-matriculation examinations and of this number, one obtained the degree of Ph.D., one the M.Sc. degree, 12 B.Sc. degrees with Honours, 1 B.Sc.Eng. (Metallurgy) degree with Honours, 7 Pass degrees in Science and 2 Pass degrees in Engineering (Metallury). During the past 11 years 127 students have graduated from the Institute and, in addition, 27 post-graduate degrees, including one D.Sc. degree, have been obtained.

Emphasis was laid on the importance of research which is now being conducted by the chief industries in this country and to the prosecution of which a valuable contribution had been made by the Institute through the many students wh ohad been trained in methods of research.

The programme of work for the present session includes a considerable extension of the course of lectures on "Coal Carbonisation" and the addition of two courses of lectures on "The Application of X-ray Analysis to Chemical Problems" and "Micro-Chemical Analysis" respectively.

Lord Riddell, who delivered the Inaugural Address, emphasised the necessity of co-operation between good salesmanship and good production and in this connection it may be pointed out that excellent facilities are provided at the Cass Institute for those engaged in the distributive branches of industry to acquire a comprehensive knowledge of the science and technology underlying their vocational work.

SASKATCHEWAN SODIUM SULPHATE DEPOSITS.

It is announced at Regina, Saskatchewan, that the Barium Reduction Corporation, of Charleston, West Virginia, will shortly erect a plant at Horseshoe Lake, near Ormiston, fifty miles south of Regina, for the manufacture of sodium sulphate from natural deposits. Production is expected by June, 1930.

The expenditure on the new plant and equipment will be approximately $500,000, and the Company is stated to have been awarded a contract for the supply annually for 10 years of 25,000 tons of crystal to the International Nickel Company, at Sudbury, Ontario, where it will be used in the reduction of nickel-copper ores.

Another company—Natural Sodium Products, Ltd., will shortly rebuild its plant at Dunkirk, Saskatchewan, which was recently destroyed by fire, and an additional $500,000 will be expended there.

Natural sodium sulphate, or salt cake, is largely used in the sulphate pulp mills of Canada for which large quantities have hitherto been imported. Production from the Saskatchewan deposits, which are numerous and total many millions of tons, was commenced in 1920. Canadian production in 1928 totalled 6,015 tons valued at $69,155. During the first half of 1929 production was 3,373 tons worth $36,383. Imports in 1928 were recorded at 38,835 tons valued at $445,244. In addition there were imports of bisulphate of soda or nitre cake amounting to 36,561 tons valued at $311,606. Nitre cake or sodium acid sulphate is used in the refining of nickel, and the natural sodium sulphate may be converted into this form by the action of sulphuric acid.

On account of the large consumption of salt cake and nitre cake in Canadian industries, the further developments expected in Saskatchewan promise to add an important branch to Canada's chemical and mining industries.

FURTHER RAILWAY CONSTRUCTION.

In a recent speech at Sault Ste. Marie, the Prime Minister of Ontario intimated that the engineers of the Temiskaming and Northern Ontario Railway were conducting surveys in the territory 100 miles north of the National Transcontinental branch of the Canadian National Railways in order to discover whether it would be advisable to extend the Provincial Government line into the Patricia district, where important mining development is in progress.

LIGNITE DEPOSITS.

Referring to recent reports relative to discoveries of lignite in the region of James Bay, the Premier of Ontario stated, in the course of a speech at Saulte Ste. Marie, that the investigating party had met with such encouraging results both in the search for lignite and oil that the Provincial Government had withdrawn a large area from staking until the whole situation could be more thoroughly investigated.

INCREASED CANADIAN COAL PRODUCTION.

During the first half of 1929 the output of coal in Canada reported by the Dominion Bureau of Statistics at Ottawa was 8,776,599 short tons worth $31,863,948, as compared with 8,248,500 tons valued at $28,943,945 during the first six months of 1928.

Imports of anthracite during the six months totalled 1,605,307 short tons, of which 1,384,751 tons came from the United States; 208,294 tons from Great Britain and 12,362 tons from Russia. Bituminous coal imports totalled 5,787,988 tons, all of which came from the United States, except 54,205 tons which were imported from Great Britain.

Of the 487 coal mines operating in Canada, 292 are in Alberta; 55 in Saskatchewan; 40 in Nova Scotia; 85 in British Columbia; 14 in New Brunswick and 1 in the Yukon Territory. There is more than $146,000,000 capital invested in these mines, which give employment to over 28,350 persons.

"ACHEMA VI."

Foreigners, we learn, are paying full attention to all particulars regarding the Exhibition of Chemical Apparatus — "Achema VI" — organised by the "Deutsche Gesellschaft für chemisches Apparatewesen E.V.", and taking place at Frankfort-on-Main from the 10th to the 22nd of June, 1930.

There have been conferences recently with the Japanese Commercial Attaché in Berlin and it is reported that on the inducement of the Japanese Government some authorities of the Japanese Chemical Industry will come to Europe to visit this Exhibition.

A fresh record was established in Nicaraguan trade last year, due to larger exports, though imports were well above those of 1927 and 1926. The British share of the import trade remained at about 11 per cent. of the total, but Germany made some headway at the expense of the United States.

THE AIR-PUMP, PAST AND PRESENT.

By E. N. da C. Andrade, D.Sc., Ph.D., M.R.I.

(Before the Royal Institution, Friday, May 31, Major Charles E. S. Phillips, O.B.E., F.Inst.P., Secretary and Vice-President, in the Chair.)

To create and conserve nothing in a jar, to make but one molecule grow when ten million grew before, may seem to the uninitiated a paltry and destructive aim, but it has nevertheless long been the task of countless men of learning, and this search after vacuity has led to some of the most important discoveries in science. On the one hand, the great advances which atomic physics has made within our lifetime—the isolation of the electron; the discovery of the X-rays with which our illustrious director has illuminated the dark places in the structure of solids; the achievements of spectroscopy, of radioactivity, and every other branch of modern physical science—are inseparably bound up with the creation of a vacuum; on the other hand, the speedy evacuation of vessels is a fundamental feature of that great branch of the electrical industry which we may comprehend in the term "lamp manufacture," the lamps in question being not only those which give out visible electromagnetic radiation, but also the thermionic valves which take part in the emission of long waves, and the X-ray tubes which generate the very short waves.

The first experiments on vacua were made by Otto von Guericke, whose earliest attempts were certainly carried out before 1652. He began by filling a cask with water and then pumping out the water with a brass fire-squirt adapted for the purpose. The attempt naturally did not succeed, the air rushing in through the crevices of the cask. Having failed to overcome this difficulty by making a smaller cask, which was put inside the larger one, the inter-space being filled with water which might reasonably be supposed to leak into the pumped-out cask more slowly than aid, Guericke prepared a copper sphere, filled with water, which was likewise pumped out with the squirt. While the pumping was in progress the sphere collapsed "with a very great noise, to the terror of all, like a cloth that is crumpled in the hand." In these early attempts we already have the fundamental principle of a great number of air-pumps down to modern times, namely to fill the space to be evacuated with some substance, liquid or solid, and then to withdraw that substance.

Guericke himself next proceeded to make a true air-pump with a solid, instead of a liquid, piston. This first effective pump is not illustrated in Guericke's own book *De Vacuo Spatio*, which was not published until 1672, but by his permission an account of it, with an illustration, was given by Gaspar Schott in his *Mechanica Hydraulico-Pneumatica*, 1657. The cylinder of the pump was arranged at a slope, so that the lower end could be immersed in water, to seal the joint with the receiver (a method commonly used in those days, anticipating our modern mercury seal), and was provided with an internal valve at the receiver end, and one valve opening into the atmosphere placed, not very advantageously, about half-way up the cylinder It was with such a pump that Guericke performed the first experiments on the properties of vacuous spaces, in particular the famous experiment of the Magdeburg hemispheres, and many others designed to exhibit the pressure of the atmosphere, which Guericke clearly understood.

Robert Boyle first heard of the air-pump through Schott's book, and set about making his much improved " 'engine," in constructing which he was materially aided by the no less famous Robert Hooke. The action of this pump was controlled by a tap between the pump-cylinder and the receiver, and by a plug valve, opened and closed by hand, controlling a port connecting the bore of the cylinder with the outside air. With this pump, and with an improved model which he made shortly after, Boyle carried out a wonderful variety of experiments, both physical and biological. He showed, among other things, that sound was not propagated, and that a candle went out, in an evacuated vessel, while the action of a magnet and of a spring were unaffected by the evacuation. He also demonstrated with various animals—cats, shrew-mice, frogs and snails—the troubles of living creatures in very attenuated air, and further, even made an apparatus for distillation in vacuo. Meanwhile various other celebrated men, including Huygens and Guericke himself, were producing pumps with various new features of construction. A great step forward was made by Boyle, aided this time by the ingenious and inventive Papin, when about 1680 he made a two-cylinder pump, the two pistons being connected by a cord passing over a pulley. With the single-cylinder pump the effort of withdrawing the piston becomes very great as exhaustion proceeds; with the two-cylinder pump one piston helps to raise the other.

The achievements in the way of piston-pumps of the preceding fifty years or so are embodied and extended in the famous two-cylinder pump of Hauksbee, described by him in 1709. The pistons are raised and lowered by a pinion-wheel engaging in two racks. With this pump Hauksbee performed the first experiments on the discharge of electricity *in vacuo*, the ancestors of so famous a line. Another experiment he performed has been the subject of a series of a series of researches by the present Lord Rayleigh. A bottle containing a little oil in which pieces of phosphorus have been allowed to stand is shaken so that the oil wets the whole interior, and placed under a receiver, which is then exhausted. As exhaustion proceeds the whole bottle suddenly becomes highly luminous, the luminosity diminishing again when the pressure becomes very low. As we are dealing with the pump itself I must not devote more time to these early experiments, but I may say that in the early years of the eighteenth century the pump was so far perfected that it became a popular means of entertainment, and Mr. Vream, for instance, in his little book published in 1717, gives no less than fifty experiments which may be performed by its aid.

The type of piston-pump built by Hauksbee continued without essential change until late in the nineteenth century, when great improvements were embodied in the so-called oil-pumps invented by Fleuss, and christened by him "Geryk pumps." A layer of oil, of very low vapour pressure, placed on top of the piston, does away with any dead space, while the closing of the cylinder at the top avoids any atmospheric pressure on top of the piston, so that even with a single cylinder it requires no effort to pump at low pressure. The cylinder is divided into two parts, the piston rod passing through the dividing diaphragm, leakage being avoided by a layer of oil on top. When the piston is raised it lifts a valve in the diaphragm, and the oil layer on top of the piston, having completely expelled all air, passes partly through the valve; when the piston is lowered oil follows it until the valve closes. In the most recent types of pump, which are run at a high speed, the pressure attained is actually below the vapour-pressure of the oil used in the pump. How this can be possible will be clearer when we have considered the modern vapour-stream pumps.

Another early method of obtaining a vacuum, figured in the *Saggi di Naturali Esperienze*, published by the Accademia del Cimento in 1666, is to fill a long tube, the closed end of which widens out into a vessel of some capacity, with mercury, and then to invert it, so that a Torricellian vacuum is produced, in which various experiments can be produced. This we may call the method of the liquid piston. Its modern descendants are the various forms of Toepler pump in general use round about the end of the last century. In these pumps a Torricellian vacuum is repeatedly produced by the raising of a vessel of mercury, and this vacuum is automatically connected with the receiver every time the vessel is lowered.

A very great advance in the technique of obtaining a vacuum was made by Gaede in 1905, when he produced his rotary mercury pump. A drum of special construction is divided into compartments which, by rotation, are successively filled with mercury, and then emptied, each compartment being connected in turn to the receiver as the emptying takes place. This is a clever adaptation of the principle of the liquid piston, which immediately obtained great popularity in all laboratories. It is to be noted that, in order that the drum may not be of unwieldy size, it is necessary to reduce the pressure in the casing which encloses the drum, so that the level of mercury inside and outside the drum may not exceed a centimetre or so. The Gaede rotary pump, therefore, had to be used in conjunction with a preliminary pump, or fore-pump (German *Vorpumpe*).

All the pumps which we have so far considered are based on purely mechanical principles, and for their understanding it is quite sufficient to consider a gas as an elastic fluid, continuous in structure. The molecular character of the gas is in no way involved, and, as we have seen, modern pumps of the type in question are merely direct descendants of pumps devised long before this molecular character was realised. It is to emphasise this point that I have adopted the historical aspect. We now turn, however, to the new types of pump, designed within the past twenty years, which are based upon what may be generally called molecular principles, and demand for their understanding a study of the physical nature of a gas. In particular the properties of gases at low pressure are involved, for the pumps in question are, so to speak, only finishing pumps, and do not come into action until a rough pump has already prepared the way for them.

According to the kinetic theory, a gas consists of molecules, which may be considered as little spheres, or, more generally, as little bodies of a more or less marked

degree of symmetry, about a hundred-millionth of an inch long, rushing about in all directions and frequently colliding with one another and with the walls of the vessel. The collisions with the walls produce the pressure. The molecules move with a very high velocity, some hundreds of yards per second for gases at ordinary temperature, and this high velocity, deduced from elementary considerations, was a point of difficulty in the early days of the theory, critics objecting that such speeds would imply very rapid diffusion, so that, for instance, the vapour of any odorous liquid should be detected by its smell at the furthest parts of a room as soon as the bottle is opened. Such criticism leaves out of account the frequent collisions, which make the path of an individual molecule a zigzag with frequent turns back on itself. The average distance between collisions is called the mean free path, and is an essential factor in all questions of diffusion and of viscous forces. It is about a hundred-thousandth of a centimetre for air at ordinary pressure, and is, to a first approximation, independent of the temperature. It varies, with a given gas, inversely as the pressure, so that at low pressures it becomes quite large: in air at a pressure of 1 microbar it is 10 cm., and at a pressure of .01 microbar, easily attained with modern technique, it is 10 metres.

Considerations of the behaviour of gases at low pressure led Gaede in 1912 to design a new type of pump, termed by him a molecular pump. Since the molecules behave as if condensed on the surface, and then quickly re-evaporated, if we move the surface rapidly we communicate a common velocity component to all molecules. If, then, part of the walls of a tube could by some means be kept in steady motion in the direction of the length of the tube a difference of pressure would be maintained between the two ends of the tube, the tendency of the gas to flow under the difference of pressure being counteracted by the drift imposed on the molecules. Calculation shows that with a given gas the *ratio* of the pressures at the two ends is fixed by the speed of the walls and the length of the tube. If the ordinary laws of viscosity were valid at these low pressures the *difference* of pressure would be fixed in this way. Clearly the ratio of pressure also depends upon the ratio of the speed of the gas molecule to the speed with which the walls move, so that at a given temperature this pressure ratio is much less for hydrogen than for a heavier gas.

(*To be concluded.*)

NOTICES OF BOOKS.

The Universe Around Us. By SIR JAMES JEANS, F.R.S. Pp. 352. The University Press, Cambridge. 1929. Price 12s. 6d.

This is another charming book from the pen of Sir James Jeans, which is written in a simple style and it is entirely free from mathematics. The subjects covered are those uppermost in the minds of experimental and theoretical physicists and chemists, the former class including astronomers. The treatment includes many things which the author discussed in his greater work ASTRONOMY AND COSMOGONY (reviewed in this Journal, 1928, *137*, 108), this book representing a simplified exposition.

Chapter I deals with *exploring the sky*, in which the solar system figures largely at the outset, then come the stars and the galactic system followed by nebulæ, and starting on page 84 *a model of the universe* is summarised in four pages. Speaking of the solar system Sir James regards Bode's law as a chance coincidence. Modifications of Bode's law or other views in this respect are not given. Books of this kind become somewhat circumscribed in their treatment —perhaps of necessity as the range is so great that it does not permit of a full treatment of the subjects within the scope of 350 pages.

Perhaps the most remarkable feature of the stars of the galactic system, or indeed stars of any system, is that they are so far apart that the chance of stellar encounters is very small. On page 88 this is worded thus: "The stars move blindly through space, and the players in the stellar blindman's buff are so few and far between that the chance of encountering another star is almost negligible. We shall see later that this concept is of the profoundest significance in our interpretation of the universe."

In this chapter relativity makes its appearance and the following lines are worthy of note: "On the other hand [referring to Einstein's universe on page 76] this simplicity is acquired at a price. The fundamental cornerstone of the whole theory of relativity is the equal partnership of space and time in the sense already explained. Einstein's cosmology gains its simplicity only at the expense of supposing that this equality of partnership disappears when we view the cosmos as a whole. It supposes that space and time are indistinguishable (in the purely formal sense already indicated) only to a being whose experience is limited to a small fraction of the universe; they become utterly distinct for a being who can range through the whole of space and

time. It is not altogether clear how much weight ought to be attached to this objection, if objection it is. Real space and real time undoubtedly are distinct. Even if we deny the reality of both, they still remain distinguishable as modes of perception. What reproach, then, can it be to a cosmology that it admits that, in the last resort, when the universe is contemplated on the grand scale, space and time resolve themselves into distinct types of entity? Somehow we know it already, before ever we begin to contemplate the universe on the grand scale." The reader of this review will doubtless find this statement of thoughtful interest and will wish to read the book thoroughly. It is a book by a thinker for all grades of thinkers who take an interest in the modern developments in the physical and chemical worlds. Here and there one might wish to replace the higher flights of thought by those of a lower standard capable of more accurate statement, but in so doing the charm and majestic sweep of the book would doubtless suffer.

Chapter II deals with *atomic explorations* while still having an astronomical bias. On page 99 it is stated that "A thermometer placed out in interstellar space, far away from any star, would probably shew a temperature of only about four degrees above absolute zero, while still lower temperatures must be reached out beyond the limits of the galactic system." Schrödinger's atom is touched upon (pp. 297-298), but it appears that nobody fully understands it.

Chapter III deals with *exploring in time*, as Jeans puts it. Starting with the age of the earth—particularly the age as deduced by means of radioactivity—the author reviews many things concluding with the annihilation of matter giving rise to radiation (p. 182) and advances a new conjecture based upon time itself which is applicable to the atom and ultimately to the universe (p. 189). As I understand it, the quantum theory is one of halts: the electrons can move in and out in the region round the nucleus in definite steps, which movement does not involve a long time as the actions are very quick when they take place; but there is a *long time possibility*, meaning that after the electrons have travelled out a sufficient time distance, so to speak, they may suddenly fall into the nucleus and neutralise a proton there and send out a flash of radiation. Jeans says: "At these longer distances the demand of the quantum theory 'thus far shalt thou go and no further,' seems to be replaced by 'thou shalt go no further until after a long time.' And it now seems possible, on astronomical evidence, that the prohibition at the shorter distance may not be absolute either." Every atom in the universe is thus doomed to destruction in time and there would be nothing left in the end but radiation moving round and round in a sort of closed Einstein universe. Jeans does not say exactly this, but it seems that his conjecture would lead to such a state of affairs if pushed to an extreme.

Chapter IV deals with *carving out the universe*. The great factor here seems to be gravitational instability. Primæval chaos (page 199) is discussed. Jeans says: "If there ever existed a primæval chaos of the kind we are now considering, it would not condense into stars, but into enormously more massive condensations, each having the weight of millions of stars."

Passing on in this fascinating study to page 226 the carving process involves—"*Chaos—nebulæ—stars—binary systems—sub-systems*, to which a sixth generation must be added if the stars of the sub-systems happen to fission further . . ." Next considered is the origin of the solar system, born from condensations of a huge filament drawn out of the sun by the accidental passage of a wandering star which came close to it. On page 241 Jeans says: "For our solar system, as for any other systems there may be in the sky, the genealogy runs as follows:

Chaos—nebula—sun—planets—satellites.

On page 243, discussing Roche's limit, it is suggested that Saturn's rings are the broken fragments of a former satellite "which ventured into the danger-zone marked out by Roche's limit. We have seen how our own moon is destined in time to contract its orbit, until it is finally drawn within the Roche's limit surrounding the earth and broken into fragments. After this the earth will have no moon, but will be surrounded by rings like Saturn."

This danger-zone theory accounts for the existence of the asteroids which before they came into being were a primæval planet between Mars and Jupiter, but this planet passed close enough to the latter planet to suffer disruption.

Chapter V deals with *stars*. To give the reader an adequate idea of the scope of this work the following quotation from pages 308, 309 will suffice: "A star begins life with a large proportion of short-lived atoms, and so at first generates energy furiously. As it ages, the shortest lived atoms dis-

appear first, and in so doing reduce the average energy-generation of the star per ton so that, as a star's weight decreases, so also must its rate of generation of energy per ton. Finally all the atoms with much energy-generating capacity have disappeared, and the star is left, a shrunken and diminished mass of atoms which have very little capacity for generating radiation.

"To put the same thing in another way, the rate at which a star generates energy per ton is proportional to the death-rate in its population of atoms. To say that Sirius generates 16 times as much energy per ton as the sun is only another way of saying that the average atom in Sirius has only a sixteenth of the expectation of life of the solar atoms; their death-rate is 16 times as high. As those types of atoms which have the highest death-rate gradually die off in any star, the average death-rate of the population decreases, or, in other words, as a star ages its capacity for energy generation per ton decreases.

"This agrees with the findings of observational astronomy. The most massive stars not only generate more energy than less massive stars, as in any case to be expected; they also generate enormously more energy per ton. This is illustrated by the following list of main-sequence stars.

Star	Weight in terms of Sun	Generation of energy in ergs per gramme
Pearce's Star *A*	36.3	15,000
V Puppis *A*	19.2	1,000
Sirius *A*	2.45	29
Sun	1.00	1.90
ε Eridani	(0.45)	0.26
Kruger *60B*	0.20	0.021

"Seares' diagram of stellar weights (p. 275) shews that this is a general property of the stars. To repeat our former metaphor, the stars squander their substance lavishly in their youth, while they have plenty left to spend, but parsimony comes over them with old age. Theoretical considerations have now given us an explanation of this phenomenon."

Chapter VI, the last one, deals with the *beginnings and endings* of things. That the universe is running down, that is to say, dissipating its mass in radiation and not rebuilding atoms seems to be the opinion held by Jeans. Jeans says on page 317: "The first law of thermodynamics, which embodies the principle of 'conservation of energy,' teaches that energy is indestructible; it may change about from one form to another, but its total amount remains unaltered through all these changes, so that the total energy of the universe remains always the same. As the energy which is the cause of all life of the universe is indestructible, it might be thought that this life could go on for ever undiminished in amount. *Availability of Energy*: The second law of thermodynamics rules out any such possibility. Energy is indestructible as regards its amount, but it continually *changes in form, and generally speaking* there are upward and downward directions of change. It is the usual story—the downward journey is easy, while the upward is either hard or impossible. As a consequence, more energy passes in one direction than in the other. For instance, both light and heat are forms of energy, and a million ergs of light-energy can be transformed into a million ergs of heat with the utmost ease; let the light fall on any cool, black surface, and the thing is done. But the reverse transformation is impossible; a million ergs which have once assumed the form of heat, can never again assume the form of a million ergs of light. This is a special example of the general principle that radiative energy tends always to change into a form of longer wave-length, never into a form of shorter wave-length. When blue light falls on a fluorescent substance, it emerges as green, yellow or red light, but the reverse transition is unknown; fluorescence always increases the wave-length of the light (Stokes' law). We have seen how fluorescent substances become visible when they are placed in the ultra-violet region of the spectrum, but no known substance becomes visible when placed in the infra-red." The whole business comes to this: Humpty-Dumpty cannot be put together again or put back upon his wall, Humpty-Dumpty representing the quantum. The *higher* the frequency the larger the quanta.

The other features which the title of this chapter implies must be studied in the original as space will not permit of more exposition of the book here.

F. H. L.

Forthcoming Events.

SOCIETY OF DYERS & COLOURISTS.

Manchester Section.

October 18, at Milton Hall, Deansgate.—"'Locust Beans in the Textile Industry." By. Dr. Tagliani.

UNIVERSITY COLLEGE, LONDON.

Monday, October 14, at 1.40 p.m.—Introductory Address to Students of all Faculties and Departments. By the Provost.

Monday, at 2.15 p.m.—" Elizabeth and her Court." A public lecture by Prof. J. E. Neale.

Monday, at 5 p.m.—" Secretion of the Digestive Juices." First of a course of four lectures by Dr. R. J. Brocklehurst. October 21, 28 and November 4.

Monday, at 5.30 p.m.—"Chemical Forces and Atomic Structure." First of a course of three public lectures by Prof. K. Fajans, of the University of Munich. October 16 and 18.

Tuesday, October 15, at 5.30 p.m.—" Aim and Method in the Study of Ancient Art." A public inaugural lecture by Prof. Bernard Ashmole.

Wednesday, October 16, at 5.30 p.m.—" Copenhagen, Past and Present." First of a course of three public lectures by Mr. J. H. Helweg. October 23 and 30. (Lantern illustrations.)

Thursday, October 17, at 5.30 p.m.—" The Elizabethan Parliament." First of a course of four public lectures by Prof. J. E. Neale. October 24, 31 and Monday, November 4. *Chairman at the first lecture : Col. the Rt. Hon. Josiah Wedgwood, D.S.O., M.P.*

Friday, October 18, at 5.0 p.m.—" The Glory of Greece.' A public lecture by Prof. G. Elliot Smith, F.R.S. (Lantern illustrations.)

Friday, October 18, at 5.30 p.m.—" The Origins of the Legal Profession in England." A public lecture by Mr. Herman Cohen, M.A., Fellow of the College. Chairman : The Rt. Hon. Sir Edward Clarke, K.C.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

A meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, 16 October, at 7.30 for 8 p.m.

The annual Pond Life and General Microscopical Exhibition will be held in the Lecture Hall and Library from 7.30 to 10 p.m. Dr. R. J. Ludford and Mr. D. J. Scourfield will give a brief description of the exhibits.

BRITISH SCIENCE GUILD.

6, John Street, Adelphi, W.C.2.

THE NORMAN-LOCKYER LECTURE, 1929.

Tuesday, November 19, at 4.30 p.m.—The above Lecture will be given by Sir Walter Morley Fletcher, C.B., K.B.E., M.D., Sc.D., F.R.S., who will speak on certain aspects of Medical Research and their applications. The Goldsmiths' Company have again most kindly placed their Hall—in Foster Lane, E.C.2.—at the disposal of the Guild for the lecture.

THE ALEXANDER PEDLER LECTURE, 1929.

Manchester. Tuesday, November 26, at 5.30 p.m.—This Lecture has been established by the British Science Guild in memory of Sir Alexander Pedler, C.I.E., F.R.S., who was for many years Honorary Secretary of the Guild. The Lecture will be an annual one, dealing with some subject of scientific interest, and will be given outside London. The first Alexander Pedler Lecture will be given by Dr. G. C. Simpson, C.B.E., D.Sc., F.R.S., on "Past Climates." It will be held under the auspices of the Manchester Literary and Philosophical Society, 36, George St., Manchester.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

28,459.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of metal carbonates. September 19.

28,489.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of readily-soluble salts of acridine bases. September 19.

28,560.—I. G. Farbenindustrie Akt.-Ges.—Apparatus for production of hydrogen peroxide. September 20.

28,679.—I. G. Farbenindustrie Akt.-Ges.—Production of valuable hydrocarbons. September 21.

28,100.—Imperial Chemical Industries, Ltd.—Generating steam and evaporating aqueous solutions. September 16.

Specifications Published.

318,937.—Crawford, J. W. C., Scharff, G. E., and Imperial Chemical Industries, Ltd.—Preparation of pigments and the like.

319,030.—Drefus, H.—Manufacture of aliphatic esters and acids.

296,428.—Epner, C.—Production of hydrogen and gas mixtures containing hydrogen.

292,129.—Montecatini Soc. Generale per L'Industria Mineraria ed Agricola. —Manufacture of ammonium salts.

319,079.—Distillers Co., Ltd., and Hutchinson, H. B.—Production of butyl alcohol and acetone by fermentation.

Abstract Published.

316,750.—Ketones, etc.—Boot's Pure Drug Co., Ltd., and Marshall, J., Station Road, Nottingham.

Acyl and alkyl phenols.—Acyl derivatives of monoalgyl ethers of catechol are obtained by heating the said monoalkyl ethers or their esters with fatty acids in the presence of phosphorus oxychloride. The acyl group takes up the *p*-position to the alkoxyl group. In examples, 5-propionylguaicol is made from guaiacol or guaiacol propionate and propionic acid, the propionyl ester of 5-propionyl guaiacol being formed as an intermediate product, and 5-acetylguaiacol from guaiacol and acetic acid. The acyl groups may be reduced to alkyl groups, for example, by the Clemmensen process, with amalgamated zinc and hydrochloric acid. The products are of therapeutic value.

The Latest TRADE MARKS

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504,937.—Chemical substances used in manufactures, and anti-corrosives, all being goods in class 1.—James Burnet Cochrane, Ashburn, Abbots Road, Grangemouth. September 25th.

KEYOTITE.

504,460.—A chemical preparation in class 1 for treating plaster or cement surfaces to prevent the action of acids on paints or wallpaper.—The Key Paint Company, Limited, trading as Keystona Paint Sales Company, Keystona House, 15, Caroline Street, London, W.C.1. September 25.

PREMAG.

505,395.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. — The Premier Electric Welding Co., Limited, Harrow Manorway, Abbey Wood, London, S.T.2. September 25.

PARATAC.

505,654.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—George Edward Margerison, trading as Geo. Margerison & Co., 1a, Plugington Road, Fulwood, Preston, Lancashire. September 25.

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MATTER AND LOGIC.

By DR. W. TOMBROCK.

The Proton as the Source of Force.

In our two last articles "The Connection between Proton and Cosmic Rays" (August 30), and "The Dawn of Chemical Thought and the Proton" (October 4), we saw that in developing that constituent of the atom, the proton, from a simple to a complex material unit a *force* makes its appearance which is a primary one, purely material, *not* psychic, and mechanically completely understandable. It is the attractive or suctional force which the proton as an ether whirlpool or cyclone exerts on the surrounding particles.

Before proceeding further, we will examine somewhat more closely the mechanism by which we have arrived at this concept of force.

Let us assume that the number of particles which take part in the cyclonic motion can be considered as practically constant but changes in the sense that particles can be continuously replaced by others and thus as many particles must come towards the proton as move away from it . . . how then may we understand the attraction or suction of the proton? Indeed just as the particles which approach the proton bring about an effect which one calls attraction or suction, so would the particles, which leave the proton, cause an opposite, repulsive action.

Must we then explain our supposed attractive or suctional action by saying that in a motion towards the centre of the cyclone the number of collisions becomes continually more numerous while in motion away from the centre the collisions become continually less numerous? At first sight this is indeed an attractive explanation.

Nevertheless, I believe that another explanation will hold water better, the same, namely, which we have already given before in explaining gravitation and indeed this: in general with the particles, which go to take part in the cyclonic motion, the translatory velocity is reduced and the rotational velocity is on the other hand increased. The actual force of recoil of the particles, which move towards the proton, would thereby be greater than that of the particles which come from the proton and this gives, on the whole, an effect which may be termed attractive or suctional.

Note, however, that in this discussion we assume that force, *qua talis, does not* exist.

Force is certainly not an independent reality possessed of a separate existence.

That which we understand by force in this case is, as we have previously emphasised, a purely arbitrary something. Force remains a fictitious, imaginary something; that which actually exists, which is real, is the number of successive collisions of the particles, which produce an effect of motion and this, for the purpose of explanation, elucidation or calculation at first gave rise to concepts of "love" and "enmity" (Empedocles) but later produced the concept of "Force." Empedocles conceived force as a half-psychical agent, we learned after him to look upon force neutrally, without, however, understanding it. And in this discussion force, the primary physical force is completely mechanically explained as residing in the constituents of the atom or at any rate made understandable. This force is passive, unreal and imaginary; it does *not*, really and actively, set the particles in motion, but it comes into being only as a means of representation for the production of the effect which is caused by the particles through their successive collisions.

In other words: it is *as if* a force residing in the centre of the proton attracts the neighbouring particles.

We have thus in these considerations already approached fairly closely to the generally current explanation.

The difference lies perhaps more in words than in concrete essential facts. But *our* idea is understandable and its implications are clearly to be perceived. The ether consists of small material particles, the motions of which are reminiscent of those of gas-molecules. In this ether there exist cyclones in which its particles, possibly the smaller ones, take part. We call these cyclones protons. They are the constituent parts of the atoms and these again form molecules; the molecules form aggregates, etc. . . . in brief: matter perceptible to the senses. It is the other, perhaps the larger, material particles, which only temporarily take part in the cyclonic motion but for the rest and precisely for this reason are responsible for various phenomena of motion—we point out that they are directional phenomena — in the ether, light, electricity, gravitation, etc. These freely moving particles are called electrons in certain phenomena and we have already seen that in our speculations the proton attracts these electrons or at least appears to do so. If now in addition one calls the result of a collision "repulsion," then one may say that also in our speculations electrons, at least apparently, mutually repel one another. One thus sees that our speculations cover the current ideas quite well.

We will now again summarise: *Thales* thought of *motion* as essential in material phenomena. *Empedocles* considered this to be what we now call *force*, *viz.*, attraction and repulsion, which actions he, however, supposed to be the manifestations of "love" and "enmity." *Democritus* saw the *atom* as the essential of matter.

In our speculations we recover the root or kernel of these three concepts, namely, *motion*, the *atom* (then, however, considered as the ultimate material-particle, *not* our extremely complex "chemical" atom) and *force*; but the last concept appears as purely fictitious and explained by the cyclonic forms of motion in protons and atoms.

Bergen op Zoom,
Holland.
September, 1929.

THE AIR-PUMP, PAST AND PRESENT.

By E. N. da C. Andrade, D.Sc., Ph.D., M.R.I.

(*Before the Royal Institution, Friday, May 31, Major Charles E. S. Phillips, O.B.E., F.Inst.P., Secretary and Vice-President, in the Chair.*)

(*Continued from page 236.*)

In Gaede's pump the walls of the supposititious tube, which has just been discussed, are constituted by grooves cut in a drum which can be set in very rapid rotation. The drum fits closely into a housing from which a tongue protrudes into each groove, dividing the groove into a low pressure side, where the walls are running from the tongue, and a high pressure side, where the walls are approaching the tongue. The high pressure side of one groove is connected to the low pressure side of the next groove, so that we have virtually several pumps in series. A preliminary pressure of a fraction of a millimetre of mercury (say .1 mm.) is necessary to ensure the efficient working of this type of pump, but with such conditions a very low vacuum can be rapidly attained. A great advantage of pumps of this type is that they deal with condensable vapour as readily as with gases.

Another form of molecular pump has been recently designed by Holweck. In this pump a spiral groove is cut in the casing, and the drum has an unbroken cylindrical surface. The depth of the groove is tapered so as to allow for the decrease of mean free path with increasing pressure. By the courtesy of Messrs. Hilger, the English

agents, I am able to show the rapidity with which a large sized Holweck pump can evacuate a vessel of some litres capacity down to a hard X-ray vacuum. No precautions have been taken to exclude water vapour.

We now turn to another type of pump which has come into great general use in the last few years. As a preliminary let us consider the influence of a volatile liquid on a vacuum, in particular the question of obtaining a high vacuum in a vessel connected to which by a wide tube is a second vessel containing liquid.

Gaede obtained some very interesting results by connecting a vessel containing a little air with a vessel of heated mercury, with an ice-cooled trap between the two vessels. If the total pressure of gas and mercury vapour were the same in both vessels, then, since there is only air in one, when the mercury is heated sufficiently to give this pressure, there should be no air in the other. However, it was found that air diffuses into the mercury vapour space against the current of vapour. The laws of diffusion are somewhat complicated, but Gaede worked out the case in detail, everything being at low pressure, and his results led him to devise his mercury vapour pump.

The principle is to let the gas diffuse into a rapid stream of mercury vapour which carries it away to a place where it can be removed by a rough pump. The vapour stream is produced by strongly heating liquid mercury; vapour which diffuses into the receiver space is condensed. Although the fore-vacuum is necessarily at a higher pressure than the receiver, gas cannot get back against the stream of mercury vapour. The pump will only work well at low pressure, for unless the mean free path is long the diffusion process does not become really operative. To render the diffusion effective Gaede used a slit, which diminishes the counter-current of mercury vapour. This case can be worked out mathematically, and it can be shown that diffusion is most effective when the width of the slit is equal to the mean free path of the gas. If the slit is too wide the density of the mercury vapour is too great, and the "brush" action of the slit loses its sharpness; if it is too narrow not enough gas molecules diffuse through. Similarly, if the vapour pressure is too high the counter-current is too vigorous; if it is too low the stream is not fast enough.

A better arrangement of the vapour stream was devised by Langmuir. In his type the vapour issues through a tube, which is surrounded by a wider tube, the walls of which are water-cooled. The tube to the receiver enters the outer tube at a point in the rear of the vapour jet. If the pressure is so low that the mean free path of the vapour is greater than the distance between the tubes, the molecules cannot diffuse back against the gas stream, but strike the wall and condense. It is true that a much lower temperature than the boiling point of mercury is needed for condensation at such low pressures, but with tap-water cooling the condensation is fairly effective. The importance of condensation is clear, and Langmuir called his pump a condensation pump, but the gas enters the vapour stream by diffusion just as in Gaede's pump. Both the original Gaede pump and Langmuir's pump are really diffusion-condensation pumps.

As diffusion is more effective with hydrogen than with other gases, say carbon dioxide, the diffusion pump should be more effective in evacuating hydrogen than with any other gas; on the other hand, I have pointed out that the molecular pump is least effective with hydrogen. To show this experimentally I have two exactly similar discharge tubes into which I introduce a mixture of hydrogen and carbon dioxide, the tubes being connected together so that the mixture is identical in each. I now close the tap between the two tubes and let a molecular pump evacuate the one, a vapour stream pump the other, for a short time. The former shows at once a pink discharge, indicating that the remaining mixture is strong in hydrogen; the latter shows a bluish discharge, indicating relative richness in carbon dioxide.

The different types of diffusion pump all need a good preliminary vacuum, as they cannot hold up against more than a slight difference of pressure without gas coming back against the vapour stream. A fore-pump producing something between a tenth and a hundredth of a millimetre of mercury should be employed. However, at higher pressures, where the diffusion effect is small, we can use the steam-injector principle, for in a jet of fast-moving comparatively dense vapour there will be a diminution of pressure corresponding to the kinetic energy of the accelerated vapour. The surrounding gas will flow in as a whole under the difference of total pressure, not partial pressure. This principle has been used for the creation of a fore vacuum by a vapour stream. In Gaede's three-stage steel mercury vapour pump, for instance, which has great speed

of pumping, there is an injection stage working at comparatively high pressure, and a diffusion stage for the lowest pressure, while in between there is a stage of mixed action.

Mercury is not the only liquid which is suitable for use in a vapour pump. Quite recently Mr. Burch, by a process of distillation in vacuo, has obtained an oil the vapour pressure of which at ordinary room temperatures is extraordinarily low. This oil can be used effectively as the working fluid in pumps. Another liquid which can be used is normal butyl phthallate. As, to the best of my knowledge, this substance has never been employed in England for this purpose, I will now use it in a small glass pump to produce an X-ray vacuum.

While we have now briefly reviewed the chief types of vacuum pumps, properly so called, it must be remembered that other processes are widely used, especially in industrial laboratories, for producing high vacua. Solid surfaces in general exercise a marked condensing action on gases, and absorb on themselves thin layers of gases at temperatures and pressures under which the substance is gaseous in bulk. Consideration of these surface actions lie outside the scope of this discourse, as do the methods of combining the residual gases chemically with a substance which deposits on the walls of the glass, by the use of the so-called "getters." We may, however, with reference to the part which the walls of the vessel play in these processes, refer to these methods as *mural* methods. If we are allowed to do this we may alliteratively divide the methods of producing high vacua into *mechanical*, described in the first part of this discourse; *molecular*, including in this term both what is ordinarily called the molecular pump and also the vapour stream pumps, since they are based upon molecular theory; and *mural*. The action of the first is perfectly understood; the action of the second is largely understood, but more difficult; the third method, though widely applied, is theoretically still very obscure in many cases.

Finally, it may be mentioned that while pressures as low as a ten-thousand-millionth of atmospheric pressure can be certainly produced in the laboratory, even at this pressure more than a thousand million molecules are present in every cubic centimetre. We are still very far from being able to produce the kind of vacuum that exists in outer space.

ELEMENTS IN THE SUN.

In the *Astrophysical Journal*, of July, 1929, there is a long article by H. N. Russell on the composition of the sun's atmosphere. The following is the opening paragraph to a long abstract given on page 11:

"The *energy of binding* of an electron in different quantum states by *neutral* and *singly ionised* atoms is discussed with the aid of tables of the data at present available. The *structure of the spectra* is next considered, and *tables of the ionisation potentials* and *the most persistent lines* are given. The *presence* and *absence* of the lines of different elements in the solar spectrum are then simply explained. The *excitation potential*, *E*, for the strongest lines in the observable part of the spectrum is the main factor. Almost all the elements for which this is small show in the sun. There are *very few solar lines* for which *E exceeds 5 volts;* the only strong ones are those of hydrogen." The two predominating metals are iron and magnesium. The two predominating non-metals are hydrogen and oxygen. There is a great deal of sodium and silicon in the sun. The order would be: H; O; Mg; Fe; Si; Na, etc. This is of course for the sun's atmosphere.

F. H. L.

THE RELATION OF CH_3CO-GROUP TO FERMENTATION-PRODUCTS.

By Tuneto Higasi.

Of the substances produced in the course of ordinary fermentation, it is observed that many have the group, CH_3CO, in their structural formulæ (*e.g.*, $CH_3.CO.CH_3$, $CH_3.CO.CHO$, $CH_3.CHO$, etc.). It is beyond doubt, therefore, that the mechanism of the decomposition by ferments will be cleared up, if a true knowledge is obtained concerning the cause of the existence of this group.

Such a group may arise from the following possible causes:

(1) Simple oxidation of $CH_3\underset{\underset{OH}{|}}{CH}—$,

(2) De-aminised oxidation of $CH_3—\underset{\underset{NH_2}{|}}{CH}—$,

(3) Dehydration of $\underset{\underset{OH}{|}}{CH_2}\underset{\underset{OH}{|}}{CH}—$, and

(4) Rearrangement of CH_2—CH—.
\ /
O

Of these cases, (1), (2), and (3) are most probable and many investigations have been carried out on them, but less is known in the case of (4). The oxide form is, however, more used than the keto- or aldehyde-form in expressing the structure of glucose or other sugars, and moreover, furfural and its derivatives, important fermentation-products of sugars, belong to nothing but γ-oxides.

On the other hand, in the case of (3), it is also possible to assume the existence of oxides as the intermediate compound, though the keto-enol rearrangement is now widely believed. Of course, those oxides have not generally been detected in the course of fermentation, but the instability of these substances, and the difficulty of their detection, must be taken into consideration. In a word, the experimental data to hand are not sufficient for deciding the theory to be right or not. Although the author has not investigated this matter he has synthesized many such oxides (such as those of butylene, amylene, mesityl oxide, etc.) in relation to the study of many glycols. He has also studied their properties especially with regard to their flavours, for the purpose of reference.

Another reason of the existence of CH_3CO-group, consists in the stability of this group which makes it remain unchanged throughout the changes in the process of fermentation (*e.g.*, $CH_3.CO.CHO \rightarrow CH_3.CO.COOH \rightarrow CH_3CHO$, etc.). By reduction, however, this group is easily changed to $CH_3CH(OH)$, which is also to be seen in many substances, *e.g.*, $CH_3CH(OH)COOH$, $CH_3COCH(OH)CH_3$, etc.

By these facts, it is natural that many methods have been worked out for the detection of this CH_3CO-group. Comparing these methods the author found the merit of the method of using sodium nitroprusside (a few drops of the solution to a drop of material or its solution) and piperidine (a drop or two of 10-20 per cent. aqueous solution) and carried out the test on more than 100 samples. The results were as follows :—

(1) Blood-red or crimson colouration was seen with all substances containing CH_3CO-group attached to the neighbouring carbon atom (*e.g.*, $CH_3CO.CH_3$, $CH_3.CO.CO.CH_3$, $CH_3CO.CH(OH).CH_3$, etc.) (2) Blue or some other colouration was seen when this group was attached to an atom of O, H, N etc. (*e.g.*, CH_3CHO, $CH_3.CO.OC_2H_5$, $CH_3.CO.NH_2$, etc.). (3) The same red colouration can also be seen with groups of C_2H_5CO, or C_3H_7CO, but not with C_6H_5CO. (4) This method has the advantage of the delicacy of colouration, and the difference in the constitution of substances may be distinguished to some extent. (5) It is suitable for the case where the substance is in a diluted or somewhat coloured solution, and at the same time the procedure is very simple.

GENERAL NOTES.

MISCELLANEOUS CHEMICAL INDUSTRY IN CANADA, 1928.

In the Miscellaneous Chemical Industry which includes chemical plants in Canada not classified to any of the main divisions of the chemical industry, production in 1928 amounted in value to $12,832,787, as compared with an output valued at $11,900,521 in 1927. This industry includes plants engaged in the manufacture of adhesives, baking powder, boiler compounds, celluloid, bakelite and artificial leather products, flavouring extracts, insecticides, polishes and dressings, sweeping compounds and other miscellaneous chemicals. In 1928 there were 128 plants in operation in this group distributed by provinces as follows : 71 in Ontario; 40 in Quebec; 2 in New Brunswick; 2 in Nova Scotia; 6 in Manitoba; 1 in Alberta; 1 in Saskatchewan; and 5 in British Columbia. Capital employed in these plants totalled $10.7 millions; employment was given to an average of 2,023 people the year round, and raw materials costing $6,088,188 were converted into commodities having a selling value of $12,832,787. Payments in salaries and wages during the year amounted to $2,487,426.

Nine separate groups have been included in this industry and the output values by groups were as follows :— Adhesives, $1,956,865; baking powder, $2,667,665; boiler compounds, $861,146; celluloid products, $2,348,226; flavouring extracts, $1,874,099; insecticides, $846,072; sweeping compounds, $106,484; polishes and dressings, $1,896,675; and miscellaneous chemical products, $1,280,565. These figures do not indicate commodity production for the substances named, but represent the output values of all firms making these articles as their major products.

DELUSTRING OF CELLULOSE ACETATE RAYON.

Discussing the delustring of cellulose acetate crêpe fabrics, a special correspondent of the *Rayon Record*, writing in the current issue, states that when cellulose acetate rayon materials are free from tension they commence to delustre readily in soap solutions maintained at a temperature of not less than 90° C. As the tension is increased, so does the minimum temperature increase at which delustring commences. Further the rate at which delustring takes place increases rapidly with increase of temperature. Thus when the crêpe fabric must also be delustred the temperature of the soap solution is suitably increased. In a limited number of instances almost complete delustring is desired, but in the majority of cases only partial delustring is necessary. It is obviously difficult to obtain regularly a specified lustre when the delustring treatment is also closely bound up with the crêpeing effect, but it is possible by careful control of the conditions of temperature and duration of treatment. Practically no control is possible by varying the concentration of the soap liquor, since it requires but a very small proportion of soap to enable full delustring to be obtained. Use, however, can be made of the discovery of A. J. Hall (E.P. 246, 879) that the delustring of cellulose acetate rayon in boiling aqueous liquors is retarded by the presence of inorganic salts. It is found that delustring in the above processes can be regulated within definite limits by adding appropriate amounts of such sucstances as sodium chloride, and particularly potassium chloride, to the soap solutions employed. If too much of these substances is used no delustring takes place at all.

After being finished to width, the crêpe fabric must be most carefully made up into the form in which it is sold, since all friction marks show clearly because they exhibit a characteristic reflection of the light falling upon them. It must also be allowed to obtain its full condition of moisture if the maximum softness is desired.

INCREASING TRADE OF NIGERIA.

For 1928 an increase in the value of both imports and exports as compared with 1927 is shown in the Nigerian trade returns. The United Kingdom's share of the grand total of £88.5 millions was 56.2 per cent., as compared with 53.5 per cent. of the £31.65 millions aggregate of 1927. Both Germany and the United States also secured larger proportions.

INTERNATIONAL AGRICULTURAL ECONOMIC COMMITTEE (ROME).

At the International Institute of Agriculture the work of the First Session of the International Agricultural Economic Committee has proceeded for three days; this committee was created by the Institute itself with the object of constituting an authoritative body which would be able to advise the most important lines of activity in the field of agricultural economics.

M. Gautier (France) was nominated President of the Session and Mr. Cohn (Denmark) general reporter.

The discussions were based on the following five reports: "Recommendations on the subject of the Institute of 1928 and measures for their application," presented by Prof. A. Serpieri (Italy); "General principles of guidance for the work of the International Institute of Agriculture," by Prof. Laur (Switzerland); "Supplementary enquiries on the general agricultural situation and the documentation of the Institute," by Dr. Posthuma and Prof. Brizi; "The development of the services of the International Institute of Agriculture as regards information relating to factors influencing price formation," by Dr. J. J. L. van Rijn (Holland); "Examination of the work of the Economic Consultative Committee of the League of Nations, in so far as it deals with agricultural questions of a practical kind in connection with the work of the Institute," by Mr. Carlos Brebbia (Argentina). The authors illustrated the essential points emphasised in their reports and a general discussion followed in which all members took part: Messrs. MacDougall (Australia), Enfield (England), Fudakowski (Poland), Popovici-Lupa (Roumania), Takeo Misu (Japan) Cohn (Denmark) Canovas del Castillo (Spain), Starcs (Latvia), and again Messrs. Gautier (France), Serpieri (Italy), Brebbia (Argentine), van Rijn (Holland), Laur (Switzerland), Brizi (General Secretary of the Institute).

Taking into account the proposals made and opinions expressed by the different speakers, a special sub-committee prepared a co-ordinated analysis of the arguments presented in the reports examined, in which important recommendations were formulated concerning the programme of work of the Institute. At two full sittings, the Committee discussed and approved these recommendations. A full sitting was devoted to the discussion of the reports presented by Messrs. Brebbia and Posthumia.

During a lunch given by the President of

the Institute to members of the Economic Committee the President of the latter, Mr. Gautier and Senator De Michelis, took the opportunity of emphasising the importance of the work completed and the influence which it would also exert in the international field towards a better stabilisation of the relations between the economic organisations of the League of Nations and the Institute at Rome.

CHEMISTRY'S GREAT ACHIEVEMENTS.

The importance and wide applications of chemical science in all phases of modern life is beginning to attract attention, not only in this country but on the Continent, too. *La Grande Œuvre de la Chimie* is the title of a special number of *Chimie et Industrie* (Paris; 49, Rue des Mathurins) dedicated to the memory of Prof. Berthelot. It has been compiled under the editorship of M. Jean Gérard and its 250 pages contain authoritative and highly instructive contributions from about 40 eminent French chemists. Every phase of applied chemistry has been described, the recent progress and further applications of the latest discoveries are well indicated in this important contribution to the general literature of chemical science.

INTERNATIONAL CONGRESS OF LEATHER CHEMISTS.

A congress of the International Leather Chemists Association has just been concluded in Prague where 300 delegates from most European countries attended a number of sessions under the presidency of Prof. Kubelka of Brno.

PHYSICAL AND OPTICAL SOCIETIES' JOINT EXHIBITION.

The Twentieth Annual Exhibition of Electrical, Optical and other Physical Apparatus is to be held by the Physical Society and the Optical Society on January 7, 8, and 9, 1930, at the Imperial College of Science and Technology, South Kensington.

As on previous occasions, there will be a Trade Section and a Research and Experimental Section, and in addition, a new section for the work of Apprentices and Learners is to be introduced.

The Trade Section will comprise the exhibits of manufacturing firms, and preliminary invitations to these exhibitors have already been issued, entries being asked for by October 18.

The Research and Experimental Section will be arranged in three groups :—

(*a*) Exhibits illustrating the results of recent physical research.

(*b*) Lecture experiments in Physics.

(*c*) Historical exhibits in Physics.

The Exhibition Committee invites offers, from Research Laboratories and Institutions and from individual research workers, of exhibits suitable for inclusion in any of the above three groups. Accommodation for these exhibits will be provided in rooms separate from those devoted to the trade exhibits; and a part of the Catalogue will be devoted to their description. No charge will be made for space or catalogue entries in the Research and Experimental Section. Offers of exhibits, giving particulars of space and other facilities required, should be communicatel immediately, and in any case not later than October 30 to the Secretary, Exhibition Committee, 1, Lowther Gardens, Exhibition Road, London, S.W.7.

The Section for Apprentices and Learners has been instituted with the object of encouraging Craftsmanship in the Scientific Instrument Trade. Apprentices and learners may exhibit, in competition, specimens of their work, providing they are in the regular employ of a firm subscribing to the Prize Fund and which is exhibiting at the next Annual Exhibition, or has exhibited once during the past three years.

IMPERIAL CHEMICAL INDUSTRIES, LIMITED.

The Directors of Imperial Chemical Industries Limited have declared, as at the 17 October, 1929, on the issued Ordinary capital of the Company in respect of the year ending 31 December, 1929, an interim dividend of three per cent. actual, less income tax at 4s. in the £, to be payable on the 2 December, 1929, to shareholders on the register as the 17 October, 1929. The register of ordinary shareholders will be closed from the 17 October, 1929, to the 31 October, 1929, both dates inclusive.

In accordance with the terms of the circular to the shareholders dated 19 April, 1929, the new issue of Ordinary shares will rank for this dividend from the 6 May, 1929, calculated on the amount per share by way of capital credited as paid up and from the due dates of the instalments.

The interim dividend in question on the new Ordinary capital at the rate of three per cent. for the part of the year will, therefore, be satisfied by the payment of a divident of 3.3879452 pence (gross) per one pound share.

The shareholders will doubtless welcome a short statement as to the position and progress of the Company.

The various industries in the home trade which consume some of the Company's major products have not in all instances shown improvement, nevertheless the volume of business in the Company's products has been maintained and in most cases increased. The volume of foreign trade also shows a satisfactory increase. Important developments are taking place in the Associated Companies in Canada, Australia and South Africa, of an entirely satisfactory and remunerative nature.

The construction programme outlined by the Chairman in his speech at the last Annual Meeting is proceeding normally, and is, in fact, in advance of schedule. The large development foreshadowed at the Billingham Works of Synthetic Ammonia and Nitrates Limited is now reaching completion. The plant which has been put into operation is working satisfactorily, and it is expected that the last unit for the production of ammonia and ammonium sulphate will commence work in the course of this month.

The expectation expressed by the Chairman at the Annual Meeting that the results of this financial year would enable the same rate of dividend as last year to be maintained on the increased capital is being fully justified and can be said to be assured.

The Company's financial position, owing to the new capital recently issued and paid up, is now very strong and liquid, and the Directors are fully satisfied with the progress of the Company and its operations during the present year.

APPOINTMENTS.

Sir Henry Payne, K.B.E., C.B., Second Secretary to the Board of Trade, has accepted an appointment under the Egyptian Government, who are desirous of his expert assistance in connection with the organisation of the Department of Commerce and Industry. Sir Charles Hipwood, K.B.E., C.B., Principal Assistant Secretary, Mercantile Marine Department, has been appointed to act as Second Secretary during the absence of Sir Henry Payne, and Mr. E. J. Foley, C.B., Director of Sea Transport, has been appointed to act in place of Sir Charles Hipwood.

TURKISH TARIFF REDUCTIONS.

By virtue of an agreement with France goods from that country are entitled to most-favoured-nation treatment on importation into Turkey, and the reductions in Turkish Customs duties provided for in the Franco-Turkish Commercial Convention of 29 August are to be applied as from 1 October. The reduced rates are applicable to goods of United Kingdom origin.

OPENINGS FOR BRITISH TRADE.

Calls for tenders are invited from Australia, British India, Canada, New Zealand, South Africa, Bulgaria, Jugo-Slavia, Latvia, *Portugal*, *Roumania*, *Egypt*, *Turkey*, Morocco and Columbia, and publicity is also given to requests from all parts of the world for agencies for British goods.

MOTOR VEHICLES IN CANADA.

A statement received from H.M. Senior Trade Commissioner in Canada shows the total number of registrations of motor vehicles in the Dominion during 1928 to have been 1,076,819, of which 921,395 were of passenger cars. Registrations in Quebec included 124,080 cars and 21,747 commercial vehicles, and in New Brunswick 25,064 and 2,668 respectively.

DRESSINGS AND COTTON FOR THE DEPARTMENT OF PUBLIC HEALTH, CAIRO.

The Commercial Secretary at Ramleh (Mr. R. M. A. Turner, O.B.E.), reports that the Department of Public Health, Cairo, is calling for tenders to be presented by the 7th December, for the supply and delivery of dressings and cotton, including Gamgee tissue, sanitary towels, various kinds of bandages, gauze and cotton wool, tow and lint, required during the year 1930-1931.

Firms desirous of offering material of British manufacture can obtain further particulars of this call for tenders on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number BX. 5748 should be quoted.

VIBRO CONVEYORS.

The Underfeed Stoker Company announce that they have secured the sole manufacturing rights for Vibro Conveyors under the Schenck-Heymann System, the conveyors being manufactured entirely at the Company's Works at Derby.

IRON OXIDES FROM CANADIAN DEPOSITS.

According to the Dominion Bureau of Statistics at Ottawa the production of iron oxides from Canadian deposits in 1928 amounted to 5,414 tons valued at $111,198, as compared with 6,125 tons worth $108,586 in 1927. Production during the first half of 1929 was 2,525 tons valued at $54,805, as against 1,414 tons worth $35,720 for the corresponding period of 1928.

The Canadian production of iron oxides is marketed in two forms, namely, crude and calcined. Crude oxides are dried before shipment, and are mostly used in the purification of illuminating gas, while the calcined product is ground usually for consumption in the paint industry.

CANADIAN STATISTICS OF MISCELLANEOUS PRODUCTS.

The Dominion Bureau of Statistics has just issued figures for the year 1928 relative to the production in Canadian chemical plants of miscellaneous articles such as adhesives, baking powder, boiling compounds, sweeping compounds, etc., the total value of which reached $12,832,787, as compared with $11,900,521 in 1927. In 1928 there were 128 plants in this group of industry, the total capital investment being $10,700,000, employees numbering 2,023.

BOARD OF TRADE INDEX NUMBER.

As measured at the Board of Trade, wholesale prices in September were slightly lower than in August, the index numbers for the two months being 81.7 and 81.8 respectively (1924=100). Food became cheaper by an average of 1.2 per cent., while industrial materials became dearer by an average of 0.5 per cent. The averages for cereals and meat and fish fell by 3.4 and 1.1 respectively, and miscellaneous foods rose by 0.8 per cent. Among industrial materials the averages for iron and steel showed little change, while those for other metals and minerals advanced by 1.6 per cent.; cotton and "other" textile materials cheapened by averages of 0.8 and 0.9 per cent. respectively, while miscellaneous materials became dearer by 1.5 per cent.

Switzerland's trade balance in June was slightly less unfavourable than in May, representing 79.5 per cent. of imports as against 75.2 per cent. the previous month. Exports to Great Britain fell from 24.8 million francs in May to 19.5 million frs. during the month under review.

THE IMPROVEMENT OF SOYA BEAN OIL EXTRACTION.

By Minoru Mashino.

The results of the author's investigations may be briefly summarised as follows :—

(1) The residue obtained on extracting the oil from soya bean by the azeotropic mixture of hydrocarbons (such as gasoline, benzene, toluene) and lower alcohols (such as methanol, ethanol) could be purified and was suitable as raw material for foodstuffs.

(2) The amount of crude soya bean oil extracted by the azeotropic mixture of hydrocarbons and lower alcohols was the greatest as compared with any other proportions of these solvents.

(3) In the extraction by a mixture of gasoline and methanol, the mixed solvent was one layer at the extraction temperature, such as 40-50° Ct., but after extraction the gasoline layer, containing soya bean oil and the methanol layer containing carbohydrates, phosphatides, colouring matter and other impurities, were separated into two layers at room temperature. On evaporating the solvent of the upper layer, purified soya bean oil was obtained. From the lower layer carbohydrates and phosphatides were recovered.

The range of proportion of the mixed solvents applicable in the above mentioned principle was also determined in the course of this investigation.

(4) The influence of the separation temperature of the two layers was also investigated. The lower the temperature of separation the greater the amount of soya bean oil extracted in the upper gasoline layer.

(5) The influence of water in the solvent upon the separation of the two layers was also studied and it was found that the 10-12 per cent. water contained in soya bean was effective in removing the oil in the lower layer to the upper one. On addition of more water to the solvent the amount of oil extracted decreased.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Manchester Section.

The first meeting of the Session was held at The Milton Hall, Deansgate, Manchester, on Friday, October 11, at 7 p.m. The following paper was read :—

Polymerisation of Drying Oils. By Dr. Cutter, of the Paint Research Station.

CRUDE OIL RESOURCES AND CRACKING PROCESS.

The total amount of crude oil in the earth's crust is unknown and unestimated, but it is assuredly a staggering volume (says *Fuel and Combustion News*). Geologists state that oil discovery is a possibility in 1,100,000,000 acres in the United States alone, or 56 per cent. of its total land area. The constrst of this huge territory with the 2,000,000 acres producing oil at the present time, makes it certain that ne wfields will be continually discovered and that the oil of that country will prove ample for many years to come. What is true regarding the potential oil production of the United States is probably true in even greater measure for many other countries in the world, where oil exploration has been even less thorough than in the United States.

From the beginning of production on a significant scale in the year 1857 to the end of 1928, the oil fields of the world produced 16,000,000,000 barrels of petroleum. But this is only a fraction of the oil resources of the producing areas. It is estimated that at most, 20 per cent. of the oil in the ground is brought to the surface by present methods of recovery. While 16,000,000,000 barrels of oil have been produced, 64,000,000,000 barrels or more are still in the oil sands. This oil alone, could it be recovered by means of flooding, repressuring or mining, would supply the world's needs for over fifty years.

SOAPS FOR SOUTH AFRICA.

His Majesty's Senior Trade Commissioner in South Africa reports that the South Africa reports that the South African Railways and Harbours Administration are calling for tenders, to be presented in Johannesburg by the 31 October, for the supply of hard pale yellow soap, soft soap and toilet soap. (Tender No. 1557.)

Firms desirous of offering soap of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number 5770 should be quoted.

DOMINION OBSERVATORY CARRIES OUT PENDULUM OBSERVATIONS IN EUROPE AND AMERICA.

The Dominion Observatory, Ottawa, has just completed a series of pendulum observations at base stations in Europe and America that is considered to the bost accurtte gravity comparison between the two continents that has ever been made. The selected stations were the Dominion Observatory which is the gravity base for Canada; the Royal Observatory, Greenwich, the base for Great Britain; the Geodetic Institute at Potsdam, Germany, the base station to which all gravity stations throughout the world are referred; and the Coast and Geodetic Survey Office, Washington, the base for the United States.

The first purpose of the work was to determine the gravity relation that exists between Ottawa and the above-mentioned bases so that the 116 gravity stations already established in various parts of Canada and the resulting investigations may be compared with similar stations and investigations of the earth's crust in other countries throughout the world. From the purely scientific point of view the results of the work have an important bearing on the theoretical shape of the earth—the question as to whether the equator is a circle or an almost round ellipse—and also upon the general equilibrium of the earth's crust. Without going into detail it may be stated that the results of the recent determination by the Observatory indicate that the general equilibrium is more circular than previous international gravity observations would indicate. While the result for Greenwich agrees well with that established by other observers, the values for Ottawa and Washington were found to be somewhat greater than the previously adopted values.

Apart from this, the work has a definite practical value which has not been lost sight of among the other considerations. Determinations of gravity, along with other physical methods, have been found to be of great practical value in the discovery of minerals and the tracing of geological structure. There is no doubt that these methods will be much developed in the future, a development to which the Dominion Observatory is contributing.

Although the observatory pendulum apparatus consists of three pendulums and two knife-edges, in effect the determinations were made by allowing a pendulum to swing freeley in an air-exhausted chamber for a period of two weeks and determining accurately at each place how much the pendulum lost or gained. At each place the pendulum was compared daily with the accurate time from the national clocks supplied by the institutions in which the observations were made. On taking the pendulum from Ottawa to Greenwich it was found that owing to the change in gravity the pendulum gained about two minutes and fifty seconds per week; at Potsdam, about three

minutes and forty-two seconds. At Washington it lost about two minutes and thirty-six seconds in the same time. From these results the comparative values of gravity at the four bases are determined by a quite simple computation. An increase in gravity makes the pendulum go faster. Gravity itself changes with latitude and height above sea level and is influenced also by local and general distribution of material in the earth's crust.

While the observer was making the pendulum observations abroad an excellent opportunity was afforded to study the methods of gravity surveys in other countries. Heretofore, especially in North America, the chief drawback to pendulum work has been the great length of time required to make accurate determination of gravity. In spite o fthis and the limited number of stations it has been possible to establish, areas of gravity anomaly bave already been located in Canada which are undoubtedly due to local peculiarities in the earth's crust, and which may in the case of the prairies be indirectly of economic importance. Partly as a result of the experience gained abroad, improvements in the method of observing are being investigated which give promise of shortening considerably the time required to make determinations, and this it is hoped will expedite the general survey of the country and at the same time make rapid investigations of the important areas disclosed by the general survey a possibility.

For the purpose of general gravity work carried on by the Observatory, and for certain other technical purposes as well, it is important that gravity should be determined with a very high order of accuracy at at least one point in Canada. As a result of last year's international determinations this is now accomplished and with the removal of the international pier at Washington, necessitated by the extensive program of building improvement in the United States capital, it is certain that the gravity pier in the Dominion Observatory has become the standard gravity base for North America.

Lieferung 308 of Abderhalden's *Handbuch der biologischen Arbeitsmethoden* (Abt. III, Physikalisch-chemische Methoden, Teil B, Heft 5 Schluss) contains three contributions dealing with the study of Colloids, *viz.*: Viscosimetry applied to Colcoidal Solutions, by Dr. Rudolf Köhler; The Estimation of Colloid-Osmotic Pressure in Biological Liquids, by Dr. Marie Wreschner; and The Estimation of the Electrical Nature of Colloids, especially Bio-Colloids, by Prof. R. Fürth. These articles are profusely illustrated with diagrams which enhance the value of the volume to the specialist and in addition this *Lieferung* will be welcomed since int includes the index to the earlier sections 7, 66, 202 and 248 as well as 303. This section costs 9 marks and is published by Urban and Schwarzenberg (Berlin and Vienna).

TENDER FOR DISINFECTANTS AND MEDICAL OILS FOR EGYPT.

The Commercial Secretary at Cairo (Mr. Richard Turner, O.B.E.) reports that the Egyptian Department of Public Health is calling for tenders, to be presented in Cairo by the 7th December, 1929, for the supply of disinfectants for medical and general purposes required during the year ending 30th April, 1931, also for the supply of medical oils required during the year commencing 1st May, 1930.

Firms desirous of offering disinfectants of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference BX. 5730 should be quoted.

DYESTUFFS (IMPORT REGULATION) ACT.

Applications for Licences in September, 1929.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during September, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 612, of which 545 were from merchants or importers. To these should be added 26 cases outstanding on the 31 August, making a total for the month of 638.

TENDERS FOR TARTAR EMETIC AND CARBON TETRACHLORIDE FOR EGYPT.

The Commercial Secretary at Cairo (Mr. R. M. A. Turner, O.B.E.) reports that the Department of Public Health, Cairo, is calling for tenders, to be presented in Cairo by the 7th December, 1929, for the supply of 760 kilos of tartar emetic and 6,800 kilos of carbon tetrachloride.

Firms desirous of offering chemicals of

Volcanic Rocks of Early Age in South-western Arkansas, South-eastern Oklahoma, and North-eastern Texas. By C. S. Ross, H. D. Miser, and L. W. Stephenson. (154-F.) 25 cents.

Exogyra Olisiponensis Shape and Exogyra Costata say in the Cretaceous of the Western Interior. By J. B. Reeside, Jr. (154-D.) 10 cents.

Algate Reefs and Oolites of the Green River Formation. By W. H. Bradley. (154-G.)

A Revision of the Flora of the Latah Formation. By E. W. Berry. (154-H.) 30 cents.

The Mother Lode System of California. By A. Knopf. (Bulletin 157.) 55 cents.

Additions to the Flora of the Green River Formation. By R. W. Brown. (154-J.) 20 cents.

The Influence of Substituted Cations on the Properties of Soil Colloids. By M. S. Anderson.

Scientific Papers of the Institute of Physical and Chemical Research, Tokyo.

"On the Transition Probability Between Two Plates with Positive or Negative Energy." By Y. Sugiura. (No. 193.) Price 1 yen.

"On the Tautomerism of 2 : 5-Dithio-piperazine." By S. Ishikawa. (No. 197.) 25 sen.

"The Near Infra-red Spectra of Helium and Mercury." By T. Takamine and T. Suga. (No. 198.) 20 sen.

"A Study of the Helium Band Spectrum. III." By S. Imanishi. (No. 199.) 25 sen.

"Experimental Studies on Form and Structure of Sparks." By T. Terada, U. Nakaya and R. Yamamoto. (No. 192.)

"Thermoelectricity of Nickel Wire." By T. Tsutsui. (No. 195.)

"Spectrophotometric Studies of Micas." By T. Yoshimura.

Forthcoming Events.

UNIVERSITY COLLEGE, LONDON.

Monday, October 21, at 2 p.m.—"Houses in Tudor Times." A public lecture by Mr. Arthur Stratton, F.R.I.B.A. (Lantern Illustrations.)

Monday, October 21, at 5.30 p.m.—"The Philosophical Approach to Modern Social Problems." First of a series of public lectures by Professor J. Macmurray, M.C. October 21 and 28, and continued in the Second Term.

Thursday, October 24, at 5 p.m.—Yates Archæological Lectures: "Greece and Greek Sites." First of a course of eight public lectures by Dr. Ernest A. Gardner. October 24, 31, November 7, 14, 21, 28, December 5 and 12. (Lantern illustrations.)

Friday, October 25, at 5.30 p.m.—"The Future of Animal Ecology." First of a Course of three public lectures by Mr. C. S. Elton, of the University Museum, Oxford. October 25, November 1 and 8.

INSTITUTE OF RUBBER TECHNOLOGISTS.

Manchester Cafe Ltd., Exchange Buildings.

October 24.—Annual General Meeting. "Application of Electricity in the Rubber Industry." By F. Walker.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Manchester Section.

Annual Dinner and Dance.—Members are particularly asked to note that the Section's Annual Dinner and Dance will be held on Saturday, November 2, at "The Manchester Ltd.," Exchange Buildings.

B. Mouat Jones, Esq., B.A., Principal of the Manchester College of Technology and Dr. J. J. Fox, O.B.E., President of the Association, are among the guests who have already promised to be present.

The Secretary will welcome applications for tables from firms interested in the Association's activities.

Tickets are 7s. 6d. per head, wines extra.

Please state, where possible, when applying for tickets, if for lady or gentleman.

H. Clayton, *Hon. Sec.*

NATIONAL SMOKE ABATEMENT SOCIETY.

Lectures on Smoke Abatement.

Friday, November 8.—"Coal and its Combustion." By Andrew McCulloch, M.Sc.Tech, A.I.C.

The processes of coal formation. The heterogeneous nature of coal. The types of coal used for industrial and domestic purposes. The burning of coal in the domestic grate and under industrial conditions. The nature of smoke.

Friday, November 15.—"Smoke and Health." By John S. Taylor, M.D., D.P.H.

The composition of smoke. Physiological effects on animal economy :— (*a*) Direct : Action on lungs and bronchial passages of solid and gaseous irritants. (*b*) Indirect : The power and effect of smoke in cutting off the visible and actinic rays of the sun. Relation to the vitamin contents of foods. Comparative measurements of solar radiation in town and country. Benefits obtained from a clean atmosphere in conjunction with good sanitary conditions.

Friday, November 22. — " Smokeless Fuels." By William Gibson, M.Sc.Tech, A.I.C.

Characteristics of a smokeless fuel, especially for domestic use. Smokeless fuels available :— Electricity, gas, oil, gas and furnace cokes, low-temperature carbonisa-cokes, various classes of coal. Their advantages and disadvantages. The production of solid smokeless fuel.

Friday, November 29.—" The Abatement of Domestic Smoke. By Marion Fitzgerald, Associate Royal Sanitary Institute.

Friday, December 6.—" The Abatement of Industrial Smoke." By R. Morton Rowe, Chief Smoke, Chemical, and Technical Inspector, Public Health Department, Manchester.

Boiler smoke as the chief factor in industrial smoke. Consideration of chief causes. Various types of boilers. The effects of steady and intermittent loads. Principles of smoke prevention and its economic aspect. Brief consideration of smoke from metallurgical and other processes, railway and traction engines, and motor behicles. The law regarding smoke nuisances. The Public Health Acts of 1875 and 1926. Power to deal with railway and traction engines; failure of law to deal with steam motors, and amendments necessary.

Friday, December 13.—" General Aspects of the Smoke Problem. By Arnold Marsh, M.Sc.Tech.

The effects of smoke upon vegetation, buildings, and other property. The monetary cost of the smoke nuisance. The economic aspect. General statistics. Smoke abatement abroad. The methods of smoke abatement propaganda.

All enquiries should be addressed to :—Arnold Marsh, M.Sc.Tech., Secretary, 23, King Street, Manchester.

BRITISH SCIENCE GUILD.

6, John Street, Adelphi, W.C.2.

THE NORMAN-LOCKYER LECTURE, 1929.

Tuesday, November 19, at 4.30 p.m.—The above Lecture will be given by Sir Walter Morley Fletcher, C.B., K.B.E., M.D., Sc.D., F.R.S., who will speak on certain aspects of Medical Research and their applications. The Goldsmiths' Company have again most kindly placed their Hall—in Foster Lane, E.C.2.—at the disposal of the Guild for the lecture.

THE ALEXANDER PEDLER LECTURE, 1929.

Manchester. Tuesday, November 26, at 5.30 p.m.—This Lecture has been established by the British Science Guild in memory of Sir Alexander Pedler, C.I.E., F.R.S., who was for many years Honorary Secretary of the Guild. The Lecture will be an annual one, dealing with some subject of scientific interest, and will be given outside London. The first Alexander Pedler Lecture will be given by Dr. G. C. Simpson, C.B.E., D.Sc., F.R.S., on "Past Climates." It will be held under the auspices of the Manchester Literary and Philosophical Society, 36, George St., Manchester.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

29,241.—Bataafsche Petroleum Maatschappij.—Separation of sludge from petroleum residues.

29,208.—Frischer, H. — Apparatus for treating nitric acid. September 26.

28,784.—I. G. Farbenindustrie Akt.-Ges. —Production of monohalogen 3 : 4 : 8 : 9 - dibenzopyrene - 5 : 10 - quinones. September 23.

28,984.—I. G. Farbenindustrie Akt.-Ges. Process for purification of sulphur. September 24.

29,340.—I. G. Farbenindustrie Akt.-Ges. Manufacture of arylamino-phenol-carboxylic acids. September 27.

Specifications Published.

289,412.—Imray, O. Y. (Elektrizitatswerk Lonza).—Process for absorbing oxides of nitrogen.

319,296.—British Celanese, Ltd., Mosby, D. H., Olpin, H. C., and Ellis, G. H.—Manufacture of nitrated aromatic amino compounds.

319,396.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges).—Purification of gas containing sulphuretted hydrogen.

319,441.—Wilson, W.—*Process for the production of ammonium carbonate.*

319,548.—Cederberg, Dr. I. W.—Preparation of nitric acid by the catalytic combustion of ammonia with oxygen of gases rich in oxygen.

Abstract Published.

317,274.—Pigments.— Busch, C. F. E., 7, Taarnhorgvej, and Sorensen, V., both in Korsor, Denmark.

Prussian blue pigments are prepared by heating ash of coal or coke with hydrochloric acid, until the liquid acquires a deep yellow colour, owing to the formation of ferric chloride. Potassium ferrocyanide is added to the filtered liquid and the resultant precipitate filtered, washed, and dried.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

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503,989.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. — Nobel Chemical Finishes, Limited, Imperial Chemical House, Millbank, London, S.W.1. October 2.

505,337. — Illustration of Stevenson's " Rocket " over Shield with Star and Ring. — Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—The Chemical and Insulating Company, Limited, West Auckland Rd., Darlington. October 2.

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MATTER AND LOGIC.

By DR. W. TOMBROCK.

The Proton, its Size and its Mass, Remarkable Properties.

The proton, when considered as a complex unit and an ether-whirl, obtains some remarkable properties.

Who, indeed, can say how large a whirlpool is and where its boundary is situated?

If we take as essentially belonging to the proton that region of space in which the particles move which come within the sphere of action of the cyclone, then its total size or content could be very great compared with the size of a separate ether-particle. If, however, one would consider as its size that space which *cannot* be taken up by another particle, then one could put forward the paradox that a proton possesses no size, given the fact that any arbitrary particle can move between the particles of a cyclone and even could traverse the centre of the cyclonic motion. It would be reasonable to consider the total volume of the separate constituent particles as the volume of the proton, but then, as has been mentioned, the question again arises: up to what limit must one take into account these constituent particles, where is the boundary of the cyclone situated?

It is thus to be expected that in the calculation of the size of the proton one will arrive at surprises.

It is possible that the size will come out much larger than one would think; it is just as well possible that it will come out much smaller. It will entirely depend on the way in which one sets about the calculation.

But the point in which the proton considered as a complex unit differs particularly from what it would be as a simple unit is in the possession or otherwise of *compressibility and expansion.*

With a simple unit, as we have already remarked, according to our principle that two material particles cannot simultaneously occupy the same place, we can no longer assume any compressibility. With a complex unit that is quite possible; indeed the mutual distances of the constituent particles can alter in this case and change of shape, compressibility and expansion become possible.

And now the mass of the proton.

It is fitting here to pay attention to a certain point . . . we have already pointed it out elsewhere (*Chem. News*, June 1, p. 337, 1928). The mass with which we deal in practice is never observed or determined by

us directly but is calculated indirectly from an observed effect. We cannot strictly logically call this mass the true or real mass but apply to it the epithet "*apparent.*" It is therefore very well possible that while a vague mass, which cannot be precisely defined, is to be expected, this nevertheless *through a definite observable effect* manifests itself to us as a definite numerical quantity; notwithstanding, this mass remains an apparent mass. This, however, does not prevent it being worth the trouble to investigate whether this apparent mass does not suggest in its character a complex unit rather than a simple material unit. According to our conception variability is especially to be expected for a complex unit, both in the underlying reality, the total mass of the particles actually taking part in the cyclonic motion, the number of which can indeed alter, as also in the external manifestation (the apparent mass). In the case of the simple proton the *real* mass would at all events have to be assumed to be constant.

Bergen op Zoom,
Holland.
October, 1929.

THE FIRST SPECTRUM OF KRYPTON.

By William F. Meggers, T. L. de Bruin, and C. J. Humphreys.
(*U.S. Bureau of Standards.*)

Ramsay and Travers (*Proc. Roy. Soc.*, lxvi, 405), discovered a new constituent of atmospheric air in 1898. They called it krypton and indicated that its spectrum was characterised by two brilliant lines for which the approximate wave lengths 5867.7 and 5568.8 A were reported. Runge in 1899, pointed out (*Astrophys, J.*, 1899, x, 73) that spectroscopically, krypton bears a close analogy to argon. Like argon it emits two different line spectra, one without Leyden jar and spark gap in the secondary circuit of an induction coil, the other with Leyden jar and spark gap. He published the wave lengths for 16 lines 4274.09 to 7601.47A) in the first spectrum, and 31 lines (3654.11 to 5419.38 A) in the second. The analogy of the first spectrum of krypton to the red spectrum of argon was further borne out by the discovery that the wave numbers of several pairs of lines showed equal differences, three pairs of lines with the difference 945 being noted by Runge.

Lists of wave lengths were also given by lxviii, 389) but only approximate values were obtained. A more complete and accurate determination of wave lengths for both spectra of krypton was completed by Baly in 1903. He gave 74 lines (3502.69 to 6456.65 A) for the first spectrum and 733 lines (2418.13 to 5871.12 A) for the second, but the stronger lines are common to both lists and some in each are identifiable with xenon. For a quarter of a century Baly's results have held first place as the most comprehensive and accurate description of the krypton spectra. An extension to the longer waves was made in 1919 by Merrill, who published the wave lengths of 41 lines (6421.1-8028.72 A) characterising the first spectrun of krypton. Approximate values for the wave lengths of 24 red lines (5994 to 7595 of the first spectrum of Kr were reported by Collie. An attempt to measure more Kr I lines was made by Otsuka in 1926, but he was able to observe only 55 lines (3665.32 to 8112.91 A) before his spectrum tubes became inoperative. Contributions to the spectra of krypton in the extreme ultra-violet have been made by Hertz and Abbink, by Taylor, and by Abbink and Dorgelo.

The electrodeless discharge was employed by L. Bloch, E. Bloch, and Déjardin to separate various stages of krypton spectra, but no new information was obtained for the first spectrum.

In addition to these general descriptions of the emission spectra of krypton, a number of investigations have been made with interferometers to determine the wave lengths of some of the stronger lines relative to the primary standard, the red radiation from Cd (6438.4696 A). The first of these was by Buisson and Fabry who measured the wave lengths of the bright green and yellow lines as 5570.2908 and 5870.9172 A, respectively. Meggers determined the wave lengths of 17 of the stronger lines (4273.9 96 to 7601.544 A) and found 5570.2872 and 5870.9187 for the green and yellow lines. The latter lines were measured by Perard who obtained 5570.2892 and 5870.9154 for their values. Finally, Weber measured three lines of Kr (5649.5924, 5870.9468, and 6456.3241) relative to Cd (6438.5038 A in air at 20° C., 760 mm Hg and 10 mm water vapour), and proposed the yellow-green line (5649.5924 A) as a primary standard to replace the red line of Cd.

Sixteen of the stronger krypton lines (4273—5871 A) were examined with Lummer-Gehrcke interferometer plates by

the lines are sharp, especially 5570 and 5870 A. According to Perard, who studied the latter lines with a Michelson interferometer, each has two close satellites. It is our intention to examine the Kr lines with a Fabry-Perot etalon of Adam Hilger's construction and to determine the hyperfine structure of complex lines.

The International Conference of Weights and Measures in 1927 provisionally adopted the red radiation from Cd (6438.4696 A) as the primary standard of wave length, but recommended that the krypton line (565 mμ) may be investigated with a view of its eventual substitution for the red ray of Cd.

This action of the conference is responsible in part for the present investigation. Since certain properties of spectral lines (pressure effect, reversibility, Zeeman effect, relative intensity) are now known to be related to the spectral terms (atomic energy levels) it appeared desirable first to classify the spectrum lines so as to be able to draw upon theoretical considerations in a discussion of the suitability of a line as a standard wave length. Before the structure of the Kr I spectrum could be successfully analysed it was necessary to make an entirely new description of the spectrum, since the older data are entirely inadequate for this purpose. The present paper, therefore, deals with a preliminary description and with the interpretation of the Kr I spectrum. In later publications, we expect to give other data on interferometer comparisons of wave lengths, studies of hyperfine structure, detection of fainter lines, and extensions of series to higher members.

As already stated, the first regularities among krypton lines were discovered by Runge in 1899. Additional constant differences between wave numbers were found by Paulson in 1914 and by Merrill in 1919.

More recently, McLennan and Ruedy undertook absorption experiments with excited krypton to assist in identifying the metastable levels. Seven infra-red lines were found to show absorption, but the terms which they involve were not identified. Ten lines of shorter wave length were reported to be associated with the separation of 4,980 cm^{-1}; only one pair appears to be real.

In a recent paper announcing the discovery of new lines in various rare gas spectra Gremmer mentions having observed three new lines (5672.4, 5993.7, and 9751.7 A) in the Kr I spectrum, and he presents a table of combinations which involve mostly infra-red lines.

The older data on the first spectrum of krypton being inadequate for an analysis, discharge tubes were prepared with krypton gas of high purity and operated to emit the spectrum of neutral Kr atoms. About 200 lines (3302.54 to 9751.77 A) characterising the first spectrum of krypton were photographed with concave grating and quartz spectrographs. From these spectrograms a new list of estimated intensities and measured wave lengths was obtained.

Analysis of these new data led to the identification of the main spectral terms analogous to those of the similarly constructed neon and argon spectra. Practically all of the Kr I lines have been classified in series of various types. From the combinations and series limits absolute term values are derived, and the ionisation potential of 13.940 volts is deduced for Kr. The general features of the Kr I spectrum are found to be closely analogous to those of the preceding rare gases Ne I and A I, and in excellent accord with the theoretical expectations.

The proposal that the krypton line 5649.56 A be substituted for the cadmium line 6438.4696 A as a primary standard of wave length is discussed. The proposed krypton standard has relatively low intensity, and it involves a metastable level. These objections do not apply to the stronger line 5870.92 A, but it can not be recommended as a standard until it has been re-examined for hyperfine structure.

PLANETARY MOTIONS AS DEDUCED FROM EINSTEIN'S THEORY *versus* THOSE BY THE NEW THEORY OF ROY J. KENNEDY.

By F. H. LORING.

When Einstein perfected his theory of relativity and in its scope it was seen to account for the extra turning of Mercury's orbit, Sir Oliver Lodge[1] raised the question whether the drift of the solar system through space, involving the more or less additive orbital velocity of the planet Mercury would, on the basis of increased mass due to velocity, account for the extra advance of this planet's orbit without invoking Einstein's gravitation theory—that is to say his theory of relativity as applied to the problem.

Prof. Eddington[2] in traversing Lodge's argument showed that "It had already been recognised that the change of mass with velocity may cause an advance of the perihelion; but owing to the ambiguity of

Newton's law of gravitation, the discussion was unsatisfactory. It was, however, clear that the effect was too small to account for the motion of perihelion, this being $\frac{1}{2}v^2/c^2$, or at most v^2/c^2. Einstein's theory is the only *one* which gives the full amount $3v^2/c^2$." v is the velocity of the planet, and c is a constant, being the velocity of light in space free from matter. Eddington further says : " It was suggested by Lodge that this variation of mass with velocity might account for the whole motion of the orbit of Mercury, if account were taken of the sun's unknown absolute motion through the æther, combining sometimes additively and sometimes negatively with the orbital motion." Eddington, however, points out that, if this were the case, other planets would give *observable* effects — Eddington, SPACE, TIME AND GRAVITATION (1921), p. 125. This theory of Einstein's, in so far as the computations for the planets are concerned, was given by me in this Journal of April 13, 1928, *136*, pp. 225 to 229.

Prof. Kennedy[3] now draws attention to the *effective charge* which Lienard[4] and Wiechert[5] developed in connection with electromagnetism and suggests that this idea appplied to gravitation is simple and leads to the calculation of the excess turning of the orbits of the planets : Mercury, Venus, Earth, Mars, with errors respectively as follows :— 0.00 ± 0.43 ; -0.05 ± 0.25 ; -0.08 ± 0.13 ; -1.8 ± 0.34.

In this formulation procedure Kennedy starts with the potential at any point 0 as given by the expression—

$$\Phi = k\,[\text{sss}]\,(\rho dV_e / r_e),$$

" integrated [sss representing the usual long s signs] over the boundaries of the body, dV_e and r_e being the 'effective' volume and radius " etc. . . . Further equations cannot be given here.

In *Case I* the mass of the planet is taken as constant and its drift through space comes out at 239 km. per second which is " by no means unreasonably large," to quote Prof. Kennedy's words, the other results being as above, while the velocity of gravitation is taken as equal to that of light (c).

The slight difference in the case of Mars may be due to an action of massive Jupiter not fully allowed for, so that on the whole the agreements are apparently very good. This theory might give the correct perturbation value here.

In *Case II* the mass of the planet is taken as variable in accordance with the equation of the Lorentz electron, " *i.e.*, the mass for acceleration in direction of motion is $m_0/(1-\beta^2)^{\frac{3}{2}}$ while for acceleration in perpendicular direction is $m_0/(1-\beta^2)^{\frac{1}{2}}$ where β is ratio of absolute velocity of planet in orbital plane to velocity of gravitation; the gravitational force depends only on the constant m_0."

Passing over pages of equations it is stated : " Thus the orbits will undergo changes of eccentricity and perihelial phase per revolution of $2\pi.5/16.e^2(v_1 v_0/c^2)\cos\omega$ and $+2\pi.1/16.e(v_1 v_0/c^2)\sin\omega$, respectively, together with a slow variation in radius. If ω is computed from the observed motion of Mercury, it is found that the elements for other planets are nearly zero; the agreement with observation is therefore good. The rate of variation of radius even for Mercury is small, somewhat below the limit of observation. However, the value of velocity of solar system in its own plane turns out so large (about 18,000 km. per sec.) that it would surely have shown itself in discrepancies in the times of transit of Jupiter's moons; the value of v_0 computed in Case I is just too small to be observable in this way.

" In view of the requirement of covariance set forth by Bateman and Einstein, a theory of the kind developed in this paper can scarcely be given great weight; nevertheless *it does seem to show that the classical* potential theory is capable of accounting for planetary motion about as accurately as does the relativity theory, if less probably."

The above is not quite a full abstract of the paper, but it will serve as an outline which may be sufficiently attractive to induce the mathematical student to study the original matter. Nothing could be more interesting than to lay all the cited papers, articles, etc., before one and study them collectively, so to speak. Attention may be here drawn to the Michelson-Morley experiments. The latest developments in this field were outlined in this Journal, March 8, 1929, *138*, pp. 145 to 147.

To the casual reader it may seem that here is a theory which undermines Einstein's theory of relativity. It would, however, take far more than this to dethrone Einstein's theory, and the probability is that it would in the end come out more victorious than ever, but one has to consider other more or less conflicting ideas as, indeed, Einstein's theory may in time become modified thereby in certain ways not yet thought of.

REFERENCES.

[1] Lodge, *Phil Mag.*, 1917, *34*, pp. 81 to 94 and 517 to 521; 1918, *35*, pp. 141 to 156.

[2] Eddington, *Phil Mag.*, 1917, *34*, pp. 163 to 167 and 321 to 327; 1918, *35*, pp. 481 to 487.

[3] Kennedy, *Proc. Nat. Acad. Sci. U.S.A.*, September, 1929, *15*, pp. 744 to 753.

[4] Lienard, *Ecl. Electr.*, 1898, *14*, pp. 417 to 424 and 456 to 461; *16*, pp. 360 to 365.

[5] Wiechert, *Archives Néerlandaises*, 1900 *5*, pp. 549 to 573.

SEARCH FOR EKA-CÆSIUM BY A MODIFIED METHOD OF POSITIVE-RAY ANALYSIS.

K. T. Bainbridge in the *Physical Review* (Sept. 1, 1929, *34*, 752) has attempted to find eka-cæsium, which is element of atomic number 87, but without success. The method of investigation, by means of positive rays, using apparatus of the Dempster type, promises well and further work in this *diretion* will be of interest, as may be judged from the concluding paragraph below.

Bainbridge's paper contains so much of interest in connection with the search for missing elements that a short account of it will be given here. After referring to various futile attempts to find element 87 and giving the various methods Bainbridge remarks :—" The speculative and unconfirmed nature of the many theories of nuclear structure does not allow a confident prediction of the radioactive characteristics of eka-cæsium. However, Hahn and Erbacher (*Phys. Zeit.*, 1926, *27*, 531) determined from a MsTh and $MsTh_2$ preparation *the non-existence* of more than 10^{-7} admixed eka-cæsium if the half life period lies between ten minutes and ten years. Hevesy (*Danske Videnskab* Selskab, 1926, 7, 1) examined $MsTh_2$ and decided less than 5×10^{-6} disintegrated to give 87." Considering spectroscopic methods the strong lines of 87 would lie in the infra-red region of low photographic sensitivity. Moreover, the presence of other alkali metals might give rise to a continuous spectrum that would mask any very faint lines of 87. Ionisation potential and resonance lines of 87 are predictable from RaII, which " provides an iso-electronic system which, by application of Moseley's law, allows a prediction of the ionisation potential and the term values for the first doublet of the principal series of eka-cæsium." Uncertainty arises, however, in the RaII spectrum. " The ionisation potential of RaII is greater than BaII, consequently for Eka-CsI, V_i is probably greater than for CsI. The $\sqrt{(\nu/R)}$ was plotted against an arbitrary abscissa length for all the alkalis and their iso-electronic counterparts in the alkaline earth metals. This was done to obtain a satisfactory value for the slope to be used for the Eka-CsI, RaII plot. A more satisfactory relation, without a simple theoretical basis however, was supplied by plotting as ordinates the ratio ν alkaline earth/ν alkali, for all iso-electronic systems, against a constant abscissa separation, while progressing from one ratio to the next for the successive elements. This method was also extended to the doublet separation ratios in order to get $\Delta\nu$ for eka-cæsium. A smooth curve of decreasing slope resulted in every case which could be extrapolated with confidence to νRaII/νEka-CsI. The weighted spectroscopic values for eka-cæsium obtained by these means are [omitting the $\pm$ values] : $V_1 = 4.05$ volts, $7^2P_{\frac{1}{2}} = 21840$ cm^{-1}, $7^2P_{\frac{3}{2}} = 19670$ cm^{-1}, $\Delta\nu$ separately determined was 1675 cm^{-1}, $\lambda 7^2S_{\frac{1}{2}} - 7^2P_{\frac{3}{2}} = 8720$, $\lambda 7^2S_{\frac{1}{2}} - 7^2P_{\frac{3}{2}} = 7600$. If the ionisation potential value for RaII is correct, then the isonisation potential of eka-cæsium being greater than that of cæsium, element 87 would not be as highly ionised as cæsium near the sun's surface (M. N. Saha, *Phil. Mag.*, 1920, *40*, 472, 809) and the absorption lines of the first doublet of the principal series might appear in the sun's spot spectrum. A search was made from 7000 A to 9000 A (SOLAR SPECTRUM WAVE-LENGTHS, Carnegie Inst. Pub., 1928, *396*). for two lines with the proper intensity ratio and wave number separation, but no lines were found . . ."

Positive-ray analysis was then tried, but the reader will have to consult the original for the details. The following from page 761 will suffice to indicate the result of this method :— " Six trials were made to detect eka-cæsium in the Cs prepared from one pollucite ore [from Oxford County, Maine, and separated according to Browning, INTRODUCTION TO THE RARER ELEMENTS (1917), 9. The powdered mineral was decomposed by strong hydrochloric acid and the acid solution treated with antimonous trichloride precipitating the double chloride of Sb and Cs. Precipitate filtered out and then hydrolysed, the antimonous oxide precipitates leaving CsCl in solution, the dissolved Sb being separated with H_2S. Eka-Cs

salts should accompany the Cs salts throughout the process]. A globule of molten Cs was held on the walls of *J* [of the mass spectrograph] by cooling with an air blast and the potential was varied over the range required to bring ions between 200 to 250 mass units into focus as the globule was evaporating. Readings were made until the globule had completely evaporated so that the determination would be independent of the vapour pressure of the eka-cæsium. No eka-cæsium was present to an amount greater than 3.5×10^{-7} of the Cs metal from the pollucite ore. With the lepidolite Cs [all the alkalis are together in this ore, thus: K 10 to 12%; Na 1 to 3%; Li 1 to 2%; Rb 0.5 to 1%; Cs 0.2 to 3%] two runs were made and no eka-cæsium was present to an amount greater than 7.3×10^{-6}. The temp. of the molten Cs was approximately 40° C. in these trials. At this temp. peaks were observed for Ca, K and Rb. At higher temps. Na and Na_2 occurred in almost equal amount, but to a very small extent when using the pollucite Cs. There was no evidence of any Cs^{+}_{2} present to more than 10^{-6}. The only molecular stream detected was Na_2. Any other molecular configurations or intermetallic compounds were dissociated if present at all. This appears anomalous in view of the fact that Na_2 has the smallest heat of dissociation (J. M. Walter and S. Barratt, *Proc. Roy. Soc.*, 1928, *A119*, 257) of any of the alkalis or their intermetallic compounds. No satisfactory explanation has yet been formulated . . . No doubly charged alkali ions were detected at all." Some words have been here abbreviated.

A new apparatus is being made that will separate ions differing in mass by 1/250. An attempt is being made to use an essentially similar apparatus to the one described in this paper to separate the isotopes of Li and K.

F. H. Loring.

For the first time since the formation of the Borax Consolidated Company, thirty years ago, no interim dividend is to be paid on the Deferred Ordinary capital. Last year the interim distribution was 2½ per cent., which was followed by a final payment of 5 per cent. Severe competition, leading to reduced prices for borax and boracic acid, is responsible. Owing to the development of the mine at California, containing a new borate mineral, operations both at mines and works have had to be reorganised.

REACTION BETWEEN LACTIC ACID AND PERMANGANATE AT LOW TEMPERATURES.

By V. Subrahmanyan, D.Sc. (London).
Indian Institute of Science, Bangalore, formerly Rothamsted Experimental Station, Harpenden, Herts.

In the course of an attempt[2] to oxidise lactic acid at low temperatures with acidified permanganate it was observed that there was persistent separation of manganese dioxide attended by the formation of acetaldehyde, acetic acid and carbon dioxide. Neither pyruvic acid nor manganous sulphate could be detected at any time.

Since the nature of the reaction appeared to be different from that at the boiling temperature[1], the formation of manganese dioxide was followed quantitatively. Mixtures containing 20 c.c. 1.427 N/10 $KMnO_4$, 10 c.c 0.9747 N/50 lactic acid and 2 c.c. 1 : 1 H_2SO_4 each were maintained at different temperatures, samples taken out and analysed iodimetrically at intervals. The results (Figure) show that all the permanganate was reduced to the oxide and that the reaction may be expressed by $2 \times MnO_4 \longrightarrow X_2O + 2MnO_2 + (8O)$. Even at the end of three weeks the quantity of the oxide remained unaltered.

It was also observed that (*a*) permanganate was reduced in much larger quantities than might have been required for the complete oxidation of lactic acid to carbon dioxide and that (*b*) at 50° C. small quantities of lactic acid remained unattacked though all the permanganate had been reduced. It should, therefore, be inferred that at low temperatures (*a*) the reaction is not entirely an oxidation and (*b*) spontaneous separation of manganese dioxide occurred even in the absence of manganous sulphate. At no single stage did the aldehyde or acetic acid occur in more than traces suggesting that the different oxidations occurred simultaneously rather than successively.

Similar but less active reactions were observed to occur in neutral and alkaline solutions.

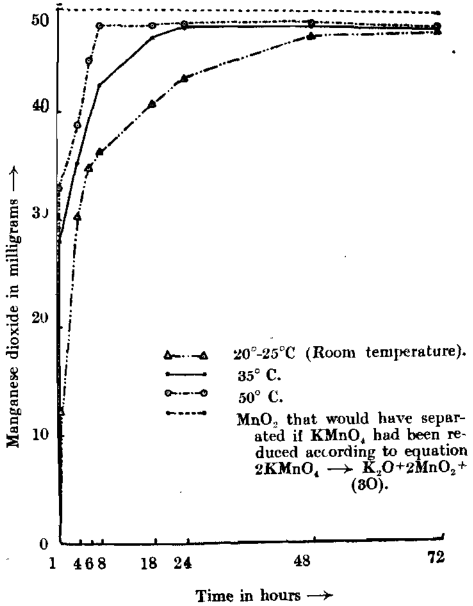
Summary.

At low temperatures lactic acid reacts with permanganate with simultaneous formation of acetaldehyde, acetic acid and carbon dioxide and separation of manganese dioxide. The reaction is not quantitative.

References.

[1] Friedemann, T. E., Cotonio, M. and Shaffer, P.A., *J. Biol. Chem.*, 1927, *73*, 335.
[2] Subrahmanyan, V., *J. Agric. Sc.*, 1929,

Fig. Separation of Manganese Dioxide at Different Temperatures.



GENERAL NOTES.

BRITISH TAR FOR BRITISH ROADS.

Loans From Road Fund May Be Conditional On Its Use.

The likelihood that "British Tar for British Roads" will become a political question of some magnitude when Parliament reassembles, is foreshadowed in the current issue of the *Chemical Trade Journal*, which indicates that the Ministry of Transport will be pressed to make a definite pronouncement on the matter and possibly, as Sir Henry Page Croft suggests, to make the use of British tar a condition of loans from the Road Fund.

"The present position," it states, "is decidedly anomalous and distinctly unfair to the important British industries dependent for their success to differing extents on the existence of profitable and adequate outlets for their make of tar. There is ample authoritative opinion which holds that for the greater part of the road-making conditions in this country, British prepared tar is both a better technical and financial proposition than imported asphalts and bitumens, whilst even those who will not go to the length of claiming actual superiority for the home-produced material, with very few exceptions admit that tar is as good as bitumen.

"Where roads drain directly into fishery rivers it may be admitted that bitumen has the advantage of relative non-toxicity, but these roads constitute at the most five per

cent. of the total road length of the country, and if the bitumen treatment were applied to them alone, tar producers would have no case for complaint. But the actual position is that there is an increasing tendency in many districts to use foreign bitumen as a dressing for roads, despite the absence of definite commercial and technical advantages on its side.

"Tar production, bound up as it is with the coal, iron and steel industries, is an essential basic industrial activity of this country. Were British tar not quite equal, value for value, to foreign material for road-making purposes a strong case would even then exist for the State promotion of its use in furtherance of the general industrial welfare of the community but, as conditions actually are, the case is overwhelming."

WORLD POWER CONFERENCE.

The great theme of the 1930 Berlin conference is the development of Power Supply and Power Utilisttion. This problem can be solved by discovering new ways of using energy; by appropriate utilisation of the energy producing plants and of the distributing systems; the storage of power; an advantageous interconnection of different power producing plants; large central stations and super-power transmission systems; lowering of the building costs; suitable propaganda and tariff systems; intelligent co-operation of the public bodies and of legislature; efficient safety measures, etc. The elucidation of the connections between the traffic systems and the questions of energy, the problems of mechanical energy-transmission, the development of coal seams, of water powers, and so on, also require detailed consideration.

In order to lighten for their colleagues all over the world the work of co-operation in the great tasks of the World Power Conference, three hundred of the most prominent experts have drawn up detailed suggestions for the preparation of papers, and these have already been sent out in large numbers to the people interested. The scientific papers which will be contributed owing to these suggestions will not be read at the Conference, but will be distributed in printed form to all participants some considerable time before the sessions begin. As an introduction to the proceedings, general reports will be read, which will give a comprehensive extract of the contributions received in each particular section and will formulate the questions to be discussed.

FOREIGN TRADE IN TUNIS.

The foreign trade of Tunisia in 1928 amounted in value to 2,913,527,000 francs, imports accounting for 1,680,175,000 francs, and exports for 1,233,352,000 francs, reports the British Vice-Consul at Tunis.

As compared with the previous year the total trade showed an increase of 115,224,000 frs., imports having declined by 91,454,000 frs., and exports having advanced by 206,677,000 frs. In other words, the balance of trade against Tunisia was reduced by 298,131,000 frs. This narrowing of the margin was due almost entirely to the fact that, whereas in 1927 the cereal crops were a failurs, in 1928 they were a success. The value of cereal imports, in fact, rose from 31,108,000 frs. in 1927 to 359,212,000 frs. last year, and imports of farinaceous foodstuffs fell from 200,881,352 frs. to 69,705,000 frs.

Unfortunately, however, for the general prosperity of the country the exports of Tunisia's two other most important products, olive oil and mining products, diminished considerably in 1928 owing to lack of demand and to competition abroad. The value of olive oil exports fell from 269,451,000 frs. to 120,194,000 frs. and those of mining products from 127,789,000 frs. to 107,230,000 frs. The country's purchasing power, on the other hand, of goods necessary for its development showed no signs of decline.

France trade with Tunisia in 1928 amounted to 1,673½ million frs., of which 1,068½ million frs. were imports and 605 million frs. exports. As compared with the previous year, the total trade increased by 295 million frs.—Imports by 7 mi8llion frs., and exports by 222 million frs. The balance of trade in favour of France, consequently, fell from 612½ million frs. in 1927 to 463 million frs. in 1928. Of Tunisia's total imports in 1928 France's share amounted to 63.6 per cent. and of the exports 49.1 per cent., as compared with 56.2 per cent., and 37.3 per cent. respectively in 1927. The French share of the total trade rose from 49.2 per cent. to 57.4 per cent.

Algeria's trade with Tunisia amounted to 220 million frs., imports being 151½ million frs., and exports 68½ million frs. As compared with 1927 the total trade showed a rise of 5 million frs., imports having decreased by 2½ million frs., and exports having increased by 7½ million frs. Algeria's share of the total foreign trade in 1928

amounted to 7.5 per cent.; of the imports 9 per cent. and the exports 5.6 per cent.

Italy's trade with Tunisia fell from 360½ million frs. in 1927 to 222 million frs. in 1928, imports having decreased from 101 million frs. to 92 million frs., and exports from 259½ million frs. to 130 million frs. The balance of trade against Italy thus fell from 158 million frs. in 1927 to 38 million frs in 1928. This was due chiefly to a decrease of 106½ million frs. in exports of olive oil and of 15 million frs. in those of phosphates, and to an increase of 19½ million frs. in imports of silk fabrics.

Belgian trade with Tunisia was valued at 91 million frs., consisting of 29 million frs. in imports and 62 million frs. in exports. As compared with the previous year the total trade was 12 million frs. greater, imports having decreased by 8½ million frs. and exports having increased by 20½ million frs., barley shipments being worth 28,400,000 frs.

The United States' trade with Tunisia amounted to 80 million frs., of which 65½ million frs. were imports and 14½ million frs. exports. As compared with 1927 the total trade decreased by 21½ million frs., imports b y16½ million frs., and exports by 5 million frs.

Trade With the British Empire.

The total trade with Great Britain in 1928 amounted to 130½ million frs., of which 46½ million frs. were imports and 84 million frs. exports. As compared with 1927 the totay showed an increase of 8½ million frs., imports having declined by 4½ million frs. and exports having advanced by 18 million frs. The British share of the total foreign trade in 1928 was 4.4 per cent.; of the imports 2.8 per cent. and of the exports 6.8 per cent.

The principal increases in imports from Great Britain in 1928 as compared with the previous year were :—In hardware, 440,000 frs.; tinplate, 252,000 frs.; and coal, 106,000 frs. The principal decreases were in cotton fabrics, 1,193,000; oils and molasses, 1,168,000 frs.; machinery and parts, 655,000 frs.; coal tar, 878,000 frs.; silk yarn 764,000 frs.; and cotton thread, 420,000 frs. No coal tar or silk yarn was imported from Great Britain last year.

The chief increases in exports to Great Britain were in barley, 28,442,000 frs; olive oil, 401,000 frs.; and olive residue oil, 83,000 frs.; the principal decreases being in phosphates, 9,678,000 frs.; iron ore, 4,793,000 frs.; alfa (esparto), 1,690,000 frs.; and goat and camel hair, 860,000 frs.

With Malta the total trade in 1928 amounted to 88 million frs., imports being 1½ million frs., and exports 86½ million frs. As compared with the previous year the total trade was 2 million frs., larger imports having decreased by a million frs., and exports increasing by 3 million frs.

British India's trade with Tunisia was valued at 9 million frs., of which 7½ million frs. were imports and 1½ million frs. exports. The principal increases in imports from India during 1928 were in woollen embroideries, 4,751,000 frs.; and oils and molasses, 215,000 frs.; and the chief decreases, jute sacks, 733,000 frs.; and tea, 167,000 frs.

Australian trade with Tunisia in 1928 consisted only of imports of coal tar, valued at 2,036,000 frs., and of household goods, valued at 1,000 frs. There was no trade between Australia and Tunisia in 1927.

While Canadas' total trade with Tunisia amounted to 27,594,000 frs. in 1927, of which 27,469,000 frs. were imports, there were no exports at all in 1928, and the imports amounted to only 464,000 frs. This huge decline in imports was due to the fact that whereas in 1927 Tunisia imported from Canada wheat to the value of 25,662,000 frs., in 1928 she required none, as her own supply was more than sufficient for her needs. Another important decrease in imports was in machinery, chiefly agricultural, amounting to 1,384,000 frs.

THE PAINTS, PIGMENTS AND VARNISHES INDUSTRY IN CANADA.

Production of paints, pigments and varnishes in Canada during 1928 was valued at $27,868,046, an increase of about 10 per cent. over the output value of $25,229,454 in 1927, according to a statement published by the Dominion Bureau of Statistics at Ottawa. Factories in operation numbered 68 of which 33 were located in Ontario, 18 in Quebec, 8 in British Columbia, 5 in Manitoba, 2 in Alberta, 1 in Nova Scotia, and 1 in New Brunswick. Capital employed in the industry totalled $24,256,008; the average number of employees was 2,881; expenditure for salaries and wages amounted to $3,967,295; materials cost $14,489,934 delivered at the works; and the value added by manufacture was $13,378,112.

Imports of paints, pigments and varnishes into Canada during the year were valued at $5,540,481 and exports (including re-exports) were worth $520,847.

IRON OXIDES.

Iron oxides produced from Canadian deposits during 1928 amounted to 5,414 tons, valued at $111,198, according to finally revised statistics just issued by the mining, metallurgical and chemical branch of the Dominion Bureau of Statistics at Ottawa. In 1927 shipments totalled 6,125 tons valued at $103,536.

The Canadian production of iron oxides is marketed in two forms, namely, crude and calcined. Crude oxides are dried before shipments, and are mostly used in the purification of illuminating gas, while the calcined product is ground usually for consumption in the paint industry.

TALC AND SOAPSTONE.

Production of talc and soapstone in 1928 was valued at $219,358, according to finally revised statistics just issued by the mining, metallurgical and chemical branch of the Dominion Bureau of Statistics at Ottawa. In 1927 shipments amounted to 16,521 tons, valued at $236,105.

Quebec shipments were made from quarries in the Eastern townships and consisted principally of soapstone blocks for use in lining the alkali recovery furnaces of sulphate (kraft) pulp mills. Ontarios' production was wholly of talc obtained from deposits near Madoc, Hastings county.

Imports into Canada during 1928 of talc or soapstone, ground or unground, amounted to 5,421 tons appraised at $91,702. Exports of talc were recorded at 10,946 tons, worth $188,601.

GYPSUM, 1928.

Shipments of gypsum from Canadian deposits during 1928 totalled 1,246,368 tons valued at $748,648 and set a new high record for the industry, according to finally revised statistics just issued by the mining, metallurgical and chemical branch of the Dominion Bureau of Statistics at Ottawa. Production (shipments) in 1927 amounted to 1,063,117 tons worth $3,251,015. Gypsum quarried in 1928 totalled 1,311,642 tons, of which quantity 226,997 tons, or 17.3 per cent., was calcined in Canada.

Quarries in Hants, Inverness and Victoria counties, Nova Scotia; Albert and Victoria counties, New Brunswick; near Paris, Ontario; Gypsyville, Manitoba; and at Falkland and Mayook, British Columbia, were worked during 1928.

Crude gypsum exported from Canadian quarries in 1928 amounted to 824,586 tons; this tonnage was shipped to the United States. Ground gypsum and prepared wall plaster exported during the year totalled 8,232* tons. The United States, New Zealand, Australia and Newfoundland were the principal importers of these materials from Canada.

BRITISH RAILWAYS IN JULY.

Receipts from passenger train traffic in July were £59,158 more than in the same month of last year. Freight train receipts were £860,343, or over 10 per cent. higher.

BRITISH IRON AND STEEL OUTPUT.

September production of pig iron showed a setback from the August output, but that of crude steel made a notable advance. The out-turn of both classes was well above the corresponding month of last year.

Yugoslavia's cement exports in the first half of 1929 exceeded by 21 million dinars those of the corresponding period last year. They totalled 224,000 tons, valued at 78 million dinars. The main destinations were Greece and Egypt.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, October 17.

The Modes of Addition to Conjugated Unsaturated Systems. Part II. The Reduction of Conjugated Unsaturated Acids by Metals Dissolving in Aqueous Media. By H. BURTON AND C. K. INGOLD.

Synthesis of Anthracene Homologues. Part. I. 2 : 6- and 2 : 7-Dimethylanthracenes. By G. T. MORGAN AND E. A. COULSON.

The necessity of preparing 2 : 6- and 2 : 7-dimethylanthracenes and the corresponding *dimethylanthraquinones* arose during an investigation of some homologues of anthracent obtained from the heavy oil distillate of a low temperature tar.

2 : 4 : 4′-*Trimethylbenzophenone* was synthesised by interaction of the Grignard compound of 4-bromo-*m*-xylene with *p*-toluonitrile and also by the interaction of *p*-toluoyl chloride and *m*-xylene under the influence of aluminium chloride. On boiling it passed by loss of water into 2 : 7-*dimethylanthracene*. The corresponding

2 : 7-*dimethylanthraquinone* was obtained by oxidation. Similarly, 2 : 5 : 4′-*trimethylbenzophenone* (prepared from 2-iodo-*p*-xylene and *p*-toluonitrile, and also from *p*-toluoyl chloride and *p*-xylene) yielded 2 : 6-*dimethylanthracene* which was converted by oxidation into the corresponding 2 : 6-*dimethylanthraquinone*.

These two isomeric dimethylanthracenes, were the subject of a critical study by Lavaux, who concluded that the first-mentioned (the 2 : 6-derivative) was 2 : 7-dimethylanthracene and the second was either the 1 : 6- or 1 : 7-isomeride. It was suggested by Seer that Lavaux's "2 : 7-dimethylanthracene" was probably identical with a compound made by himself, and of which the structure was shown by him to be most probably that of 2 : 6-dimethylanthracene (and later rigidly proved by Flumiani). A direct comparison of products made by the methods of both Seer and Lavaux with the authors' product has established the identity of all three preparations.

The authors' 2 : 7-dimethylanthracene is identical with Lavaux's 1 : 6- or 1 : 7-derivative.

Part II. 2 : 3 : 6-Trimethylanthracene.

Certain distillates from low-temperature tar contain anthracene homologues, including a hydrocarbon, m.p. 245°, giving analytical values corresponding with either di- or tri-methylanthracene and yielding a quinone, m.p. at 240°. These m.p. are close to those of 2 : 6-dimethylanthracene and its quinone, but the two hydrocarbons are not identical, and since the coal-tar product differs from the hitherto known trimethylanthracenes the synthesis of 2 : 3 : 6-trimethylanthracene, both products being ox-undertaken, as it appeared likely that the new hydrocarbon might have this constitution.

For this purpose 2 : 4 : 5 : 4′-tetramethylbenzophenone was obtained through the interaction of *p*-tolunotrile and the Grignard compound of 5-iodi-ψ-cumene, a condensation which determines the constitution of the ketone, and it was also prepared by condensing *p*-toluoyl chloride with ψ-cumene. On heating to its b.p. this ketone reacted in two ways :— (1) it lost hydrogen to yield 2 : 3 : 6-trimethyl-9-anthrone, (2) it became dehydrated to furnish 2 : 3 : 6-trimethylanthracene, both products being oxidisable to 2 : 3 : 6-trimethylanthraquinone. The hydrocarbon from low-temperature tar (m.p. 240°) and its quinone are identical with the corresponding synthetic products.

A supplementary synthesis was achieved by condensing 4-methylphthalic anhydride with *o*-xylene, when 3 : 5 : ′3-trimethylbenzophenone-6′-carboxylic acid was obtained, which by dehydration and ring closure yields 2 : 3 : 6-trimethylanthraquinone. 4-Methylphthalic anhydride was condensed similarly with toluene to furnish 2 : 6-dimethylanthraquinone.

Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part I. The Triarylbenzenylamidines. By A. W. CHAPMAN

When either of the two diphenyl-*p*-tolylbenzenylamidines I and II

$NPh_2.CPh : N.C_7H_7$ (I)

$NPh : CPh.N(C_7H_7)Ph$ (II)

is heated at 300° or above, reversible isomeric change takes place involving the migration of a phenyl group from one nitrogen atom to the other. The final product at 322-323° is an equilibrium mixture containing 35 to 40 per cent. of I and 65 to 60 per cent. of II. The re-arrangement is completely analogous structurally with tautomeric changes involving mobile protons or anions, but, unlike most of such changes, is probably intramolecular and similar in mechanism to the isomeric change of the iminoaryl ethers. The significance of the ratio of the isomerides present in the equilibrium mixture is discussed.

Studies of Valency. Part XIV. An Optically-active Telluronium Salt : p-tolylphenylmethyltelluronium Iodide. By T. M. LOWRY AND F. L. GILBERT.

Curves are given showing the mutarotation of *l*-*p*-tolylphenylmethyltelluronium *d*-bromocamphor-π-sulphonate and for the *l*-*p*-tolylphenylmethyltelluronium iodide prepared from it. Mutarotation has also been observed in the *d*-iodide prepared from the *d*-camphor-β-sulphonate.

Part XV. Optically-Active p-*Tolyl Phenyltelluroxide.*

p-Tolyl phenyltelluroxide, precipitated from the *d*-camphor-β-sulphonate is lævorotatory, and from the *l*-camphor-β-sulphonate is dextrorotatory, both salts undergoing rapid mutarotation.

THE GEOLOGICAL SOCIETY.

The adjourned meeting of the Society took place on Wednesday, October 23, at 5.30 p.m., when the following communications were read :—

...Historic Changes of Level in the Delta of the Rhone. By R. D. OLDHAM, F.R.S., F.G.S.

At Home Among the Atoms. By PROF. JAMES KENDALL, M.A., D.Sc., F.R.S. xvi + 270. London: G. Bell & Sons, York House, Portugal St., W.C. 1929. Price 7s. 6d.

The title and the sub-heading (A First Book of Congenial Chemistry) prepare the reader for an informal treatise on the chemistry of the atom. Prof. Kendall begins by classifying the *things* of the universe into *substances* with definite and distinct properties. These substances, mostly quite complex, are next shown to be capable of dissection into a limited number of simple *elements*. Following upon this, attention is turned to atoms as the smallest individual particles of which all elements are composed. Finally, the inner structure of the atom itself is revealed as an orderly complex of protons and electrons.

The informal manner of the author may be illnstrated from the chapter headings. Thus the Laws of Constant Composition and Multiple Proportion are elucidated under the title "A Few Figures." "Oxygen: the Working Girl" describes Priestley's discovery and the use Lavoisier made of it. The preparation and properties of hydrogen are similarly discussed under the heading "Hydrogen: a Nice Baby." "Valencia" refers, of course, to Valency. "Pep and Popularity" refer to the manifestations and transformation of chemical energy and the 'order of activity' of metals and non-metals.

There is no chapter xiii, the author's reason being that it would be unlucky! Besides, Nature herself avoids it, for no element has an atomic weight of thirteen! What does the author think of the element of Atomic Number 13? Chapter xiv deals with "The Apartment House" (*i.e.*, Mendelejev's Classification of the Elements) *Mendelejeff Court* being the Periodic Table. The first three groups are described as belonging to first, second and third floors; then the author abandons Mendelejeff Court because lanthanum and the rare earths 'overcrowd' a single room. Then we are told, with apt quotations from Mr. H. G. Wells, that "The Alchemists were Right" in their views regarding the transmutation of the elements.

In "Re-writing the Constitution," the significance of isotopes, electronic energy, transmutation and other phenomena are discussed. The chapter "Bohrville," sketches the various views on the structure of the atom and the book concludes with a stimulating enquiry, "What of the Future?"

An immense field has thus been covered and the subject is presented in a style calculated to appeal to non-scientific readers. Chemists themselves will also find the volume worthy of perusal.

With the exception of the sketches of the apparatus for the 'measurement of combining proportions' (p. 56) and an oxygen cylinder (p. 88) the illustrations are good, but one must doubt the authenticity of the picture (p. 182) representing Faraday washing apparatus for Sir Humphry Davy.

J. G. F. DRUCE.

Forthcoming Events.

THE GEOLOGICAL SOCIETY.

The first Ordinary General Meeting of the Session 1929-30 will be held on Wednesday, November 6, at 5.30 p.m., when the following communications will be read:—

"Fossil Insects of the South Wales Coalfield." By H. Bolton, D.Sc., F.R.S.E., F.G.S.

"The Glaciation of Clun Forest, Radnor Forest, and some Adjoining Districts." By Major A. R. Dwerryhouse, D.Sc., F.G.S., and A. A. Miller, M.Sc.

THE INSTITUTION OF MINING ENGINEERS.

Cleveland House, 225, City Road, E.C.1.

Wednesday, October 30, at 11 a.m.—Fortieth Annual General Meeting of The Institution of Mining Engineers will be held, by kind permission, at the Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1. The President, Professor Henry Louis, M.A., D.Sc., will take the chair. The following paper will be read: "Abstract of Report on the Underground Conveying and Loading of Coal by Mechanical Means." By Robert Clive.

NATIONAL SMOKE ABATEMENT SOCIETY.

LECTURES ON SMOKE ABATEMENT.

Friday, November 8.—"Coal and its Combustion." By Andrew McCulloch, M.Sc.Tech, A.I.C.

The processes of coal formation. The heterogeneous nature of coal. The types of coal used for industrial and domestic purposes. The burning of coal in the domestic grate and under industrial conditions. The nature of smoke.

Friday, November 15.—"Smoke and Health." By John S. Taylor, M.D., D.P.H.

The composition of smoke. Physiological effects on animal economy :— (*a*) Direct: Action on lungs and bronchial passages of solid and gaseous irritants. (*b*) Indirect: The power and effect of smoke in cutting off the visible and actinic rays of the sun. Relation to the vitamin contents of foods. Comparative measurements of solar radiation in town and country. Benefits obtained from a clean atmosphere in conjunction with good sanitary conditions.

Friday, November 22. — " Smokeless Fuels." By William Gibson, M.Sc.Tech, A.I.C.

Characteristics of a smokeless fuel, especially for domestic use. Smokeless fuels available :— Electricity, gas, oil, gas and furnace cokes, low-temperature carbonisa-cokes, various classes of coal. Their advantages and disadvantages. The production of solid smokeless fuel.

Friday, November 29.—" The Abatement of Domestic Smoke. By Marion Fitzgerald, Associate Royal Sanitary Institute.

Friday, December 6.—" The Abatement of Industrial Smoke." By R. Morton Rowe, Chief Smoke, Chemical, and Technical Inspector, Public Health Department, Manchester.

Boiler smoke as the chief factor in industrial smoke. Consideration of chief causes. Various types of boilers. The effects of steady and intermittent loads. Principles of smoke prevention and its economic aspect. Brief consideration of smoke from metallurgical and other processes, railway and traction engines, and motor behicles. The law regarding smoke nuisances. The Public Health Acts of 1875 and 1926. Power to deal with railway and traction engines; failure of law to deal with steam motors, and amendments necessary.

Friday, December 13.—" General Aspects of the Smoke Problem. By Arnold Marsh, M.Sc.Tech.

The effects of smoke upon vegetation, buildings, and other property. The monetary cost of the smoke nuisance. The economic aspect. General statistics. Smoke abatement abroad. The methods of smoke abatement propaganda.

All enquiries should be addressed to :—
Arnold Marsh, M.Sc.Tech., Secretary,
28, King Street, Manchester.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

MANCHESTER SECTION.

Annual Dinner and Dance.—Members are particularly asked to note that the Section's Annual Dinner and Dance will be held on Saturday, November 2, at " The Manchester Ltd.," Exchange Buildings.

B. Mouat Jones, Esq., B.A., Principal of the Manchester College of Technology and Dr. J. J. Fox, O.B.E., *President of the* Association, are among the guests who have already promised to be present.

The Secretary will welcome applications for tables from firms interested in the Association's activities.

Tickets are 7s. 6d. per head, wines extra.

Please state, where possible, when applying for tickets, if for lady or gentleman.

H. Clayton, *Hon. Sec.*

BRITISH SCIENCE GUILD.

6, John Street, Adelphi, W.C.2.

THE NORMAN-LOCKYER LECTURE, 1929.

Tuesday, November 19, at 4.30 p.m.—The above Lecture will be given by Sir Walter Morley Fletcher, C.B., K.B.E., M.D., Sc.D., F.R.S., who will speak on certain aspects of Medical Research and their applications. The Goldsmiths' Company have again most kindly placed their Hall—in Foster Lane, E.C.2.—at the disposal of the Guild for the lecture.

THE ALEXANDER PEDLER LECTURE, 1929.

Manchester. Tuesday, November 26, at 5.30 p.m.—This Lecture has been established by the British Science Guild in memory of Sir Alexander Pedler, C.I.E., F.R.S., who was for many years Honorary Secretary of the Guild. The Lecture will be an annual one, dealing with some subject of scientific interest, and will be given outside London. The first Alexander Pedler Lecture will be given by Dr. G. C. Simpson, C.B.E., D.Sc., F.R.S., on "Past Climates." It will be held under the auspices of the Manchester Literary and Philosophical Society, 36, George St., Manchester.

UNIVERSITY COLLEGE, LONDON.

Friday, October 25, at 5.30 p.m.—" The Future of Animal Ecology." First of a Course of three public lectures by Mr. C. S. Elton, of the University Museum, Oxford. October 25, November 1 and 8.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

30,197.—Bronn, J. I.—Manufacture of ammonium chloride. October 4.

29,701.—Caro, N., and Frank, A. R.—Production of cyanamides. October 1.

30,279.—*Chemical Engineering & Wilton's* Patent Furnace Co., Ltd.—Treatment of ammoniacal liquor. October 5.

30,155.—Coley, H. E.—Manufacture of metallic nitrides and ammonia from nitrogen. October 4.

30,157.—Coley, H. E.—Manufacture of cyanides from nitrogen. October 4.

Specifications Published.

289,063.—I. G. Farbenindustrie Akt.-Ges. —*Manufacture of shaped masses* from cellulose derivatives of higher fatty acids.

293,001.—Schering-Kahlbaum Akt.-Ges. — Process for the manufacture of hydrogenation products.

319,642.—Distillers Co., Ltd., and Hutchinson, H. B.—Production of butyl alcohol and acetone by fermentation.

19,839.—Evans, P. H., and Bowden, Dr. R. C.—*Acid-concentrating* and like towers.

294,118.—Soc. of Chemical Industry in Basle.—Manufacture of basic derivatives of substituted quinoline-carboxylic acids.

Printed copies of the full published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

317,396.—*Contact sulphuric acid manufacture.*—Calco Chemical Co., Inc., Boundbrook, New Jersey, U.S.A. (Assignees of Laury, N. A., 157, Foxhurst Road, Rockville Centre, Long Island, New York, U.S.A.)

A vanadium catalyst for the production of sulphuric acid is applied to a carrier of passive non-friable diatomaceous particles, e.g., chips of a natural diatomaceous earth aggregate which have been fired to a temperature of 1,000° C.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

FORESTIT.

505.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes. — The Firm trading as E. Merck, Frankfurterstrasse 250, Darmstadt, Germany. October 9th.

LAWES'.

501,265.—Fertilisers, insecticides, weed killer (chemical).—Lawes' Chemical Manure Company, Ltd., 59, Mark Lane, London, E.C.3., and 22, Eden Quay, Dublin, Irish Free State. October 9th.

TECHNICAL TRANSLATIONS.

Translations from and into French or German undertaken by a competent linguist. Charges moderate. Enquiries invited.—J. L. c/o *Chemical News.*

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

WANTED, *Chemical News*, January 6, 1928.—G. E. Stichart & Co., 2, Star Yard, Carey Street, London, W.C.2.

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DICTIONARY OF EDUCATIONISTS.
By REV. J. E. ROSCOE, M.A.
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This is an interesting and useful Work, giving in tabloid form Biographical Sketches of Prominent Educationists from the earliest times and in all countries. Mr. Roscoe has written many important books, but none of greater importance in its own sphere than the above Work.

MATTER AND LOGIC.

BY DR. W. TOMBROCK.

The Proton : Energy or Matter?

Bacon in his *Novum Organum* points out to us various astonishing aspects shown by natural science in his day under the influence of the peculiar cultivation of logic which was then in force. He warns the reader against these as follows : Book 1, XXXVIII.

" The Idols and false notions which are now in possession of the human understanding, and have taken deep root therein, not only so beset men's minds that truths can hardly find entrance, but even after entrance obtained, they will again in the very instauration of the sciences meet and trouble us, unless men being forewarned of the dangers fortify themselves as far as may be against their assaults."

In other words we do not easily get rid of wrong but long-cherished ideas, and it is indeed certain that Bacon's remark will have the right of existence as long as our science has not reached a final unalterable or at any rate permanently stable stage. This stage has, however, certainly not been attained yet and there are " false notions " or " Idols " now just as much as then. Only now these are produced less from untrustworthy dialectic and over-pedantic deduction methods than from inaccuracy and slovenliness in the argument.

In the days before Bacon logic was rated too high, it was believed that all problems could be solved by means of reasoning proceeding from a few fundamental principles. Also the course of the demonstration was generally a different one from the present. Now this course, more inductive in general is rather like this : given a glove, I will indicate to you the character of the lady who has worn it; then it was : given the lady we will say what kind of gloves she ought to wear. If now one takes into account that actually in both cases the lady in question remains behind the scenes, then one will immediately see the advantage which the modern method has over the earlier one.

We, however, here remind the reader that, as we have already pointed out before, induction and deduction are never sharply distinguished from one another. It has thereby come about that on the other hand, because of previous history, because of the opposition of Bacon and others logic, *qua talis*, is now held in too low estimation. This is, however, certainly wrong. Logic is and remains the cement which holds together the

fabric of every scientific system and logic is just as necessary in induction as in deduction. But in the days of Bacon one could not, to employ a much used comparison, see the trees for the wood, now, on the other hand, one does not see the wood for trees.

A fresh beginning was indeed made after Bacon. Certainly even less without general principles as before. They began again to embroider science on the canvass of these principles; nowadays one appears to get rid of this canvass; one embroiders on through over-specialisation, without proper contact with the canvass of the first principles. If one would have it expressed differently; we, to-day think too formalistically . . . this word was coined by a prominent mathematical physicist!

What is a liquid?

A state of aggregation.

What happens when a liquid boils?

The one state of aggregation, the liquid, passes over into the other, the vapour form.

These two answers are faulty, incorrect and unpermissible on a strictly logical examination. The correct answer in this case is: a liquid is matter in a particular state of aggregation; it passes over on boiling from one state to the other.

Now the error in the two first answers, as far as the questions themselves are concerned, are not so great and one usually—*through carelessness and love of ease*—overlooks them. But the consequences of the way of thinking lurking in the incorrect answers are very serious and have a much greater purport than would at first sight be suspected.

One overlooks implicitly that motion presupposes something which moves, namely, matter, and falls at the same time already partially in a more general error, namely to regard the sum of the properties of a thing as the thing itself.

If one does not take care, one gets the same in a consideration of the constituent of the atom, the proton, when this is contemplated as a complex material unit.

What indeed is the proton (in our discussion)?

A cyclonic form of motion of material particles.

What is energy?

A form of motion. Thus: the proton is energy. The error, which is finally made, is a consequence of the error in the first answer and this is the same as that in the example about the liquid.

The proton is, strictly logically, *not* a complex of material particles in a particular form of motion (the cyclonic). The proton is in this case *not* energy but matter in a particular state of energy (in state of energy . . . "state" is here really redundant; energy has already been defined as form or state of motion. This is not, however, a serious mistake against logic but *strictly speaking* it should be "*the proton is matter with a particular energy.*")

But now for the point which it was my intention to make. Do you see now how easily one can confuse energy with matter through inaccuracy and carelessness? The statements, "matter is energy" and also "matter can be transformed into energy and *vice versa*" are "Idols" or "false notions" of the present time. And one cannot easily get rid of them; which may here at the same time count as an undesired but indeed deserved tribute to the sagacity of the founder of the inductive method . . .

The Electron.

In our very first discussions we assumed that the protons, considered as simple, were larger material particles, larger than the ether-particles and electrons.

On further developing this starting-point we arrived at conceiving the protons no longer as simple but as complex, a complex *material unit in a cyclonic state of motion*; in brief, a cyclone of ether-particles.

This alteration of our conception of the structure of the proton calls at the same time for an altered conception of the size of the electron. It is namely difficult to understand how a difference in character can exist when the electron is the same size as an ether-particle which takes part in the cyclonic motion of the proton. An electron *taking part in this motion would then* simply become a part of the proton. This now is *not* plausible. Everything points to a distinct difference between the proton and the electron.

Now the (apparent) mass of an electron is, in my opinion, 1 : 1800 of that of a hydrogen atom, thus of a proton plus an electron.

We ought thus to put the mass of an ether-particle taking part in the cyclonic motion considerably lower still.

Approximately how large then?

Mendeléeff put the weight of the Newtonian atom at about one millionth of that of hydrogen—let us accept this weight provisionally in order to form an idea in some degree or other of things—then expressed

apparent mass of a proton would be 1800 times as great as the apparent mass of an electron and one million times as great as the *apparent* mass of au ether-particle. It goes without saying that it certainly does not follow from these ratios that a proton must consist of a million particles; everything is apparent in this case and so a proton can in reality consist just as well of a thousand million particles.

One will meanwhile admit that the mechanism of the atom becomes much clearer with this alteration of the relations.

That the protons as ether-whirls can drag along with them a heavier electron—heavier than one of the ether-particles whirling in the cyclone—in their motion and (apparently) attract it, is in every respect plausible. And also it becomes understandable that these heavier electrons, as supposed by Rutherford and Bohr, may describe between or through the ether-cyclones, orbits, both fixed and variable. And one may even see how it was possible that physicists paid more attention originally to electrons as constituents of the atom than to the actual constituents, namely the protons.

Finally our interpretation of light as primarily emission, secondarily ether-disturbances, also gains much in clearness when the electron is assumed to be heavier.

Bergen op Zoom,
Holland.
October, 1929.

THE NEW PERIODIC TABLE AND ATOMIC STRUCTURE.

By Ingo W. D. Hackh.
(*College of Physicians and Surgeons of San Francisco, Calif.*)

In the new periodic table the elements are divided into Divisions A and B, which are respectively above and below the dividing line :

Division A

Pb	Bi	Po	—	Rn	—	Ra	Ac	Th
Sn	Sb	Te	I	Xe	Cs	Ba	La	Ce
Ge	As	Se	Br	Kr	Rb	Sr	Y	Zr
.Si	P	S	Cl	Ar	K	Ca	Sc	Ti
C	N	O	F	Ne	Na	Mg	Al	Si
			H	He	Li	Be	B	C

Division B

Ti		V	Cr	Mn		Fe	Co	Ni		Cu	Zn	Ga		Ge
Zr		Cb	Mo	Ma		Ru	Rh	Pd		Ag	Cd	In		Sn
Ce	Pr	Nt	Il	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf
Hf		Ta	W	Re		Os	Ir	Pt		Au	Hg	Tl		Pb
Th		Bv	U											

To division A belong the noble metals, inert gases and light metals. Each of these elements differs from the preceding or following one by the number of electrons in the outermost shell or orbits, hence in passing from one to the next higher atomic number, the additional electron is always added to the *outermost* shell or orbits.

27	Co	2,	8,	13,	4
28	Ni	2,	8,	14,	4
29	Cu	2,	8,	15,	4
30	Zn	2,	8,	16,	4
31	Ga	2,	8,	17,	4
32	Ge	2,	8,	18,	4

In this list the electron distribution for the elements of Division B is given as the systematic one. Actually there is an interchange between these two outer shells by the establishment of more or less stable configurations; thus, *e.g.*, for manganese :

2, 8, 13, 2 for divalent Mn
2, 8, 12, 3 for trivalent Mn
2, 8, 11, 4 for tetravalent Mn
2, 8, 9, 6 for hexavalent Mn
2, 8, 8, 7 for heptavalent Mn

and correspondingly :

2, 8, 13, 00 for manganous ion
2, 8, 12, 000 for manganic ion, etc.

The elements of Division B are thus characterised by possessing polyvalency, that is more than one valency, and thus forming more than one series of compounds.

Some of the elements of Division A are apparently polyvalent; as the non-metals which generally form also than one series of compounds. But in this polyvalency

PERIOD	Electrons K L M N O P Q	4 (Carbon Group)	5A	6A	7A	Group 0	Inert gases: Electrons K L M N O P	1A	2A	3A	4 (Carbon Group)	Electrons K L M N O P Q	PERIOD
			NON-METALS			INERT GASES		LIGHT METALS					
	K L M N O P Q	4	5	6	7	8	K L M N O P	1	2	3	4	K L M N O P Q	
Vb	2 8 18 32 18 4*	82 Pb	83 Bi	84 Po	85 -	86 Rn	2 8 18 32 18 8	87 -	88 Ra	89 Ac	90 Th	2 8 18 32 18 8 4*	VI
IVb	2 8 18 18 4*	50 Sn	51 Sb	52 Te	53 I	54 Xe	2 8 18 18 8	55 Cs	56 Ba	57 La	58 Ce	2 8 18 18 8 4*	Va
IIIb	2 8 18 4*	32 Ge	33 As	34 Se	35 Br	36 Kr	2 8 18 8	37 Rb	38 Sr	39 Y	40 Zr	2 8 18 8 4*	IVa
IIb	2 8 4*	14 Si	15 P	16 S	17 Cl	18 Ar	2 8 8	19 K	29 Ca	21 Sc	22 Ti	2 8 8 4*	IIIa
Ib	2 4*	6 C	7 N	8 O	9 F	10 Ne	2 8	11 Na	12 Mg	13 Al	14 Si	2 8 4*	IIa
O					1 H	2 He	2	3 Li	4 Be	5 B	6 C	2 4*	Ia
	K L M N O P Q						K L M N O P					K L M N O P Q	
			HEAVY METALS										
III'	2 8 8* 4	22 Ti	23 V	24 Cr	25 Mn	26 Fe 27 Co 28 Ni		29 Cu	30 Zn	31 Ga	32 Ge	2 8 18* 4	III'
IV'	2 8 18 8* 4	40 Zr	41 Cb	42 Mo	43 Ma	44 Ru 45 Rh 46 Pd		47 Ag	48 Cd	49 In	50 Sn	2 8 18 18* 4	IV'
V''	2 8 18 18* 8 4	58 Ce	RARE EARTH METALS: 59 Pr 60 Nd 61 Il 62 Sm 63 Eu 64 Gd 65 Tb 66 Dy 67 Ho 68 Er 69 Tm 70 Yb 71 Lu									72 Hf	2 8 18 32* 8 4	V''
V'	2 8 18 32 8* 4	72 Hf	73 Ta	74 W	75 Re	NOBLE METALS: 76 Os 77 Ir 78 Pt		79 Au	80 Hg	81 Tl	82 Pb	2 8 18 32 18* 4	V'
VI	2 8 18 32 18 8 4	90 Th	91 Br	92 U				* indicates the shells or orbits to which electrons are added.					VI
		4	5B	6B	7B	Group 8		1B	2B	3B	4		

THE NEW PERIODIC TABLE.

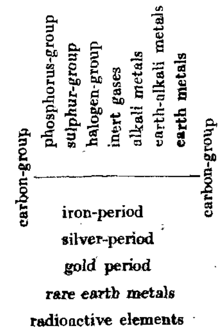
Showing Atomic Structure and *Classification of the Elements.*

only the valence shell is concerned which loses or gains electrons in the different stages of oxidation and reduction; thus,

2, 8, 8 for monovalent Cl (chlorides) = 7+1
2, 8, 7 for neutral chlorine
2, 8, 6 for monovalent Cl (hypochlorites)... ... ... = 7 - 1
2, 8, 4 for trivalent Cl (chlorites) ... = 7 - 3
2, 8, 2 for pentavalent Cl (chlorates) = 7 - 5
2, 8, 0 for heptavalent Cl (perchlorates) ... ... = 7 - 7

The distribution of electrons within these different K, L, M, etc., shells or orbits depends upon the quantum numbers and is not indicated in order to preserve the compactness and simplicity of the table.

Characteristic of the new table is that the properties of the elements in Division A are similar in the vertical direction (group relation) and in Division B in the horizontal direction (period relation). Thus we may illustrate the relationship by classifying the elements as follows:



To Division B belong the heavy metals, rare earth metals and noble metals. Each of these elements differs from the preceding or following one by the number of electrons in the second outer shell or orbits (the third outer shell or orbits for the rare earth); hence in passing from one element to the following one, the additional electron is normally added to the *second outer* (or third outer) shell or orbits.

The difference between Divisions A and B is then that all elements of A differ only by the electron arrangement of *one*, namely, the outermost shell or orbit; while the elements of Division B involve the electron arrangements of *two* (or three) shells or orbits. The number of electrons in these various shells can be read from the table where their distribution in the K, L, M, etc., shells is indicated for the elements of the carbon group and the inert gases. Thus the atomic number and the electron distribution for the elements from silicon to germanium is, according to the table:

	Division A				
14	Si	2,	8,	4	
15	P	2,	8,	5	
16	S	2,	8,	6	
17	Cl	2,	8,	7	
18	A	2,	8,	8	
19	K	2,	8,	8,	1
20	Ca	2,	8,	8,	1
21	Sc	2,	8,	8,	3
22	Ti	2,	8,	8,	4
	Division B				
23	V	2,	8,	9,	4
24	Cr	2,	8,	10,	4
25	Mn	2,	8,	11,	4
26	Fe	2,	8,	12,	4

The elements of the carbon group are listed on both sides, for they form the frame work of the system and play the part of transition elements. Their electron distribution is given on both sides, and the electron configuration of any other element can be obtained by simply adding the proper number of electrons to the indicated shells.

Many chemical and physical properties depend upon the similarity of the electron distribution. The number in the outermost shell determines many characteristics; thus the properties in Division A change most rapidly with increasing atomic number (hence group relationship), less rapidly in Division B (hence period relationship) and least of all in the rare earth metals, where the electrons are added to the third shell. However period relationship exists in Division A when the electron configuration are similar; as, in the isosters Ne, Na^{+}, Mg^{++}. Likewise group relationship exists in Division B; as, the isomerism of chromates, *molybdates* and *tungstates*, compared with sulphates and selenates. The classical periodic system stressed group relationship and neglected period relationship, except in the case of the triads Fe, Co, Ni; Ru, Rh, Pd; and Os, Ir, Pt. The new table justifies the comparison of Ag, Cd, In, or Au, Hg,

Tl, etc., etc., as similarily related groups of elements.

In summarising the properties of the elements the new table shows :

DIVISION A.—All elements who differ with successive atomic number by a different number of electrons in the *outermost* shell only, hence involve only one shell. They are characterised by simple spectra and strong electro motive force; that is they readily lose or gain additional electrons. They have a large atomic radius, hence a low density. To this division belong :

Non-metals, the elements located on the left part which have a tendency to grasp additional electrons and thus complete their octet; hence are negative or acid forming.

Inert gas, the elements located in the centre which have an octet in their outer shell and hence a valency of zero.

Light metals, the elements located on the right part which have a tendency to lose their valence electrons, thus form positive ions; hence are positive or base forming. Their density is below 4.00.

DIVISION B.—All elements who differ with successive atomic number by a different electron configuration involving *two* or *three* shells. They are characterised by complex spectra and weak electromotive force. They have a small atomic radius, hence a high density. They form many coloured compounds, double salts, and co-ordinate compounds, and are distinctly polyvalent, that is form more than one series of compounds. Their density is above 4.00, hence they are spoken of as heavy metals. Period relationship is predominating; hence we may speak of an iron, silver, gold, rare earth, and radioactive period. Group relationship exists, hence those on the left are weakly electro-negative and resemble the non-metals in some of their compounds; those on the right are weakly electro-positive and resemble the light metals.

INORGANIC NOMENCLATURE.

The July issue of the *Recueil des Travaux chimiques des Pays-Bas* contained a paper (in French) by Prof. W. P. Jorissen dealing with the work of the Commission for the Reform of Nomenclature in Inorganic Chemistry, of which Prof. Jorissen is chairman. Some of the terms approved and the alternatives selected are given and are intended to serve as a guide to editors, authors, and scientists generally.

RELATION OF TEMPERATURE OF FERMENTATION TO QUALITY OF SAUERKRAUT.

By E. A. MARTEN, W. H. PETERSON, E. B. FRED, AND W. E. VAUGHAN.

The importance of temperature control in sauerkraut manufacture is becoming better appreciated, but until now only cursory observations, rather than accurate measurements under well-regulated conditions, have been made. Since the temperature of cabbage as it comes into the factory may vary from 85° F. to as low as 32° F., depending upon weather conditions, temperature control has been adopted in many factories. Great differences of opinion exist, however, as to the best temperature at which to carry out the fermentation. Some prefer to operate at a temperature of 70° to 80° F., while others let the temperature fall as low as 50° F. The higher temperature has the advantage of inducing a rapid formation of acid, but this is offset by a tendency to produce soft and pink sauerkraut.

The authors have never been able to make sauerkraut of good quality at 80° F. It was possible to obtain a sufficiently high acid concentration in a short time at this temperature, but the product still possessed the characteristic odour and flavour of raw, sour cabbage, rather than that of sauerkraut. At elevated temperatures (75° to 80°) there is also serious danger of producing soft and slimy sauerkraut and at times pink. In a previous study of the relation of temperatures to commercial sauerkraut production, it was found that the best sauerkraut was produced when temperatures between 55° and 65° F. existed in the vat. This paper is a continuation and extension of the previous work, and the results now obtained substantially confirm it as to the best temperatures at which to produce sauerkraut.

The sauerkraut was made either in 10-gallon stone jars or in 45-gallon barrels. Early Copenhagen and All Seasons cabbage were used. Sixty pounds of cabbage were packed in the jars and 300 pounds in the barrels. Two and one-half per cent. of salt was used in all cases. The following three ranges of temperatures were studied :

-10 to 50°, 55 to 60°, and 70° F.

The fermentations at 70° F. were carried out in a greenhouse where the temperature was maintained by means of thermostat control. The fermentations at 55° to 60° were conducted in a basement, the temperature being regulated by means of steam heat and air circulation. The low-temperature fermentations, -10 to 50°, were made in

barrels placed outside of the building, where they remained from December to March.

The sauerkraut made at 70° F. was only fair in quality; that which was made at 55 to 60° was good in every instance, and that which stood outside did not become sauerkraut at all but was merely spoiled cabbage. This material was rotted to the depth of a foot or more at the top and at the bottom, was raw and contained no appreciable amount of acid. Although such extreme conditions do not prevail in the making of sauerkraut the results show in an exaggerated form some of the effects which may be expected when sauerkraut is made at low temperatures.

Other experiments were conducted in a commercial sauerkraut factory. The cabbage used was the All Seasons variety and had been stored outside ofr about a month in a well-ventilated hay-covered pile, and had a temperature of about 38° F. when brought to the factory for cutting. As it left the cutter it fell through a chute where it was heated by means of a steam jet to the particular temperature desired.

The vats at high and medium temperatures were opened at the end of 35 days. The low-temperature vats contained so little acid at this time that they were left to ferment and were first opened at the end of 158 days.

The quality of the sauerkraut which was produced at the highest temperature was only fair judged from the standpoint of flavour, colour, and texture. High temperature undoubtedly favours the production of sauerkraut of soft texture and pink colour, for numerous soft and pink portions of sauerkraut were found in both vats. It has also been demonstrated in the laboratory that fermentations conducted at high temperatures tend to produce pink sauerkraut. The finest grade of sauerkraut was obtained from the vats kept at intermediate temperatures. The sauerkraut from these vats was white and crisp throughout. The cabbage fermented at the lowest temperature produced sauerkraut that was poor in quality, and possessed a bitter taste, poor texture, and a dark colour.

The sauerkraut from the different vats showed no essential difference in percentage content of fermentation products. The quality of sauerkraut depends upon something other than mere acidity. While a proper degree of acidity may be taken as the first requisite, there are other products, as yet not measured, which distinguish a sauerkraut of good flavour from one of poor flavour.

The quality of sauerkraut is thus found to depend very largely upon the temperature at which fermentation was carried out, the most favourable temperatures for fermentation is between 60° and 65° F.

High temperatures favoured the production of soft and pink sauerkraut.

A rise of 3° to 5° F. occurred during the first eight days in fermentation vats kept at temperatures above that of the surrounding air. This rise in temperature was coincident with the greatest activity of the bacteria and is believed to have been caused by bacterial action.

—University of Wisconsin, *Jl. of Agricultural Research.*

GENERAL NOTES.

COPPER SMELTER EXPANSION.

Noranda Mines, Ltd., has decided to double the capacity of its concentrator in order that facilities may be available for the milling of 1,000 tons of ore daily. The concentrator has been handling recently between 250 and 300 tons per day, this being the maximum quantity of milling ore which it has been possible to supply owing to the limited shaft capacity.

The second smelter unit will be brought into production about the middle of November. At present the smelter at Noranda is handling about 1,200 tons of ore per day running over $5 per ton in gold and over 7½ per cent. copper, an improvement on the August recovery of $4.76 in gold with 7.29 per cent. copper.

Among the developments to be carried out shortly are the sinking of No. 3 and No. 4 shafts to a depth of 1,500 feet, this work to be begun as soon as possible in conjunction with the bringing into production of the second smelter unit. Diamond drilling carried on several months ago located the downward extension of the "H" ore-body below the 1,000-foot level. At the western end of the mine there has been located what is either a new ore-body or the downward continuation of "B" ore-body, ore having been reached as low as approximately 1,600 feet vertical depth. The Company has satisfied itself that a large tonnage of high-grade ore exists below the 1,000-foot level. Plans for the copper refinery are making rapid progress, but no definite announcement is to be made by the Company until its

exact size is determined and the site purchased.

The contract with the Hudson Bay Mining and Smelting Company for the handling of blister copper from the Flin Flon mine has necessitated an alteration in the plans. It may be recalled that Noranda Mines, Ltd., has incorporated the Canadian Copper Refineries, Ltd., in conjunction with the British Metals Corporation and the Nichols Copper Company of New York.

THE CANADIAN IRON AND STEEL INDUSTRY.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner of Canada in London its Final Report on " Iron and Steel and their Products in Canada," giving figures for the year 1927.

From the manufacture of primary iron to the fabrication of an immense variety of steel products, both for the some trade and for export, Canada's iron and steel industry extends over so wide a field that it reflects in a large measure the general economic situation throughout the Dominion.

The Report, which is published in a booklet of 157 pages, opens with a comprehensive review of production and trade, giving a general description of the numerous enterprises which in the aggregate constitute the Canadian iron and steel industry. Employing more than 106,000 persons, the 1,148 plants in the iron and steel industry representtd in 1927 a capital investment of $638,914,898 and produced commodities having a selling value of $525,021,839. At this figure the value of the outpue was some $20,000,000 higher than in the preceding year and the highest on record since 1920. It is probable that quantity production in 1927 was greater than in any preceding year.

A chapter is devoted in the booklet to each industrial group represented in the industry, these including pig iron, steel ingots and rolled iron and steel products; castings and forgings; boilers, tanks and engines; agricultural implements; machinery; automobiles; automobile parts and accessories; bicycles; railway rolling stock; wire and wire goods; sheet metal products; hardware and sools; miscellaneous iron and steel products; and concludes with a directory showing the names and addresses of the firms whose products are reported upon in the booklet.

ABRASIVES.

There were last year nine concerns in Canada producing natural abrasives and twelve manufacturing artificial abrasives. These 21 establishments represented a capital of $7,765,723, employed an average 854 people and reported a total production valued at $7,242,303.

Shipments of diatomite last year amounted to 368 tons valued at $8,960, this coming from deposits at East New Annan, N.S., and Quesnel, B.C. During the first six months of 1929, the production of diatomite amounted to 219 tons valued at $5,580.

During 1928, development work was done on a garnetdeposit in Baudin Township, Que., and a small experimental shipment was made to the United States. Further development work was carried on from July to December, 1928, by the Labelle Nickel and Garnet Co., at their deposit in Joly Township, Quebec.

Shipments of grindstones, pulpstones and scythestones from Canadian quarries in 1928 totalled 1,855 tons, worth $100,960; consisting of 1,609 tons from New Brunswick and 246 tons from British Columbia. In 1927 shipments were recorded at 2,251 tons, valued at $125,017.

Operations in the volcanic dust industry are centred on deposits near Waldeck, Sask., where there has been an annual production during each of the past five years. Duriug 1928 shipments amounted to 485 tons, valued at $9,795. The previous year's production was 105 tons valued at $785. For the first six months of 1929 production amounted to 215 tons, valued at $3,455.

Manufactures of artificial abrasives and abrasive products in Canada amounted in value to $7,122,588 in 1928. This was an increase of 16 per cent. over the corresponding selling value for 1927. The principal products were: fused alumina, 39,418 tons, worth $3,786,118; crude silicon carbide, 19,008 tons, valued at 2,098,190; and abrasive wheels valued at $847,489. Other products were ferrosilicon, abrasive cloth and paper, firesand and sharpening stones.

For 1928, reports were received from 12 plants of which 11 were in Ontario and 1 in Quebec. Capital employed amounted to $7,317,105 distributed as follows: cost of lands, buildings, equipment, $3,793,462; supplies and stock on hand, $884,250; and cash, trading and operating accounts and bills receivable, $2,639,393. The average

number of employees was 691 and salaries and wages for the year totalled $1,048,521. Materials used in manufacturing cost $2,169,428 at the works, and the value added by manufacturing processes was $4,958,160.

PATENTS COMMITTEE.

BOARD OF TRADE ANNOUNCEMENT.

The Committee, which was set up under the chairmanship of the Right Hon. Sir Charles Sargant to consider whether any amendments in the Patents and Designs Acts, or any changes in Patent Office practice, were desirable, are continuing their meetings at the Board of Trade for the purpose of hearing evidence from interested persons and associations. Four meetings of the Committee took place before the vacation, and during the next few weeks evidence will be taken from representatives of Trade Marks, Patents and Designs Federation, Ltd., the British Science Guild, the London Chamber of Commerce, the International Association for the protection of Industrial Property (British Group) the Association of British Chemical Manufacturers and the Chartered Institute of Patent Agents.

Any persons or associations who desore to submit any further suggestions, or to give evidence, are invited to communicate with the Secretary, Mr. R. W. Luce, Industrial Property Department, Board of Trade, 25, Southampton Buildings, W.C.2.

Proceedings and Notices of Societies

INSTITUTE OF METALS.

Methods of Research in Metallography. By DR. G. MASING.

The Institute of Metals Dusseldorf Meeting, September 9-12.

"Metallography" is the study of metals from the point of view of their structure. Not all researches on metals are of a metallogarphic character—for example, measurements of their physical properties, such as density, electrical conductivity, optical reflecting power, and magnetism are, in the first place, purely physical problems, and become metallographic problems only when they are considered in relation to the structure of the metal and to the changes which take place in that structure by chemical, mechanical, or heat-treatment.

Now what exactly do we mean by the structure of a metal? In the first place, we mean the nature and arrangement of the crystallites as revealed by the microscope; this naturally leads us, on the one hand, to a consideration of the macrostructure, such, for example, as is shown at the fractured surface of a metal or alloy, and, on the other, to the sub-microscopic structure. Many problems of structure—the nature of the individual kinds of crystals, their arrangement, and their state of stress—cannot be solved by means of the microscope, but can now be investigated by the help of X-rays, which reveal to us the nature of the basic lattice upon which the crystal structure is built up. The space lattice or elementary cell must, therefore, be considered as being within the realms of metallography, the natural boundary of which is, to-day, the atom. The minute structure of the atom is outside metallographic discussions at present, for although we can effect changes in the space lattice of metals by alloying, mechanical treatment, etc., we cannot yet alter the structure of the atom. Perhaps this statement is not quite accurate, as a change in the space lattice must necessarily, in some way or another, imply a certain amount of change in the structure of the atom, and when we can measure this change then consideration of the minute structure of the atom will come within the field of metallographic discussion.

Metallography can be divided into two parts—chemical metallography, which deals with the relations of the metals to one another (alloying), and physical metallography, which is concerned with the behaviour of metals and alloys under varying physical conditions, especially plastic deformation. The problems and methods of research in these two branches differ widely from one another, and it is difficult to say which is the most important branch. The physical branch deals with the general principles of the metallographic structure of metals, and on this account may be considered as the basis on which is built the chemical branch dealing with the combinations and structural changes caused by other metals. Historically, however, the science has developed otherwise, as it was found to be possible to study the structure of alloys by the aid of the theory of heterogeneous equilibria without touching deep physical questions. As this theory has been developed during the course of the last fifty years, and applied with success to numerous systems, it may now be considered to be

fully worked out theoretically. Consequently to-day the largest amount of theoretical interest is shown in the study of the physical side of metallography. From the practical point of view, however, the chemical side is the more interesting, and I assume that those who are concerned with the technical problems of metallography will confirm my opinion that problems of alloying, of the correct choice of already known alloys for special purposes, and the best method of producing new alloys, are of the greatest importance to the practical man. The preparation of an alloy is still the easiest and most efficient method of obtaining the desired properties, and must always precede other means of producing the result, such as thermal treatment. I must confess that I was originally more interested in the physical side of metallography myself, and was only induced to turn my attention, at first somewhat against my will, towards alloying questions as a result of my practical experience with alloys.

The systematic science by the aid of which we survey alloy systems and study their interrelationships is the science of constitution based on the principles of heterogeneous equilibria, and its results are summarised in an equilibrium diagram. In reviewing, then, the methods of metallography, we have first to consider those used in the construction of this diagram.

It must always be borne in mind that the laws of heterogeneous equilibria are based upon, and are just as well established as, the classical laws of thermodynamics. This fact is often, unfortunately, overlooked, not only in Germany but also in England, and equilibrium diagrams are still occasionally published which are in direct contradiction to the phase rule. Such diagrams, it should be emphasised, are equivalent to setting up a type of perpetual motion.

The use of the phase rule in constructing equilibrium diagrams has often been objected to on account of the necessity that arises sometimes of altering the experimental results to bring them into accord with the rule, and these corrections are held to be inadmissible. My reply to this contention is that experimental results which are contrary to the phase rule are themselves erroneous. Further, when any equilibrium diagram is constructed on the basis of experimental results, extrapolation and interpolation are used for the intermediate points, and in such a diagram there is thus always a hypothetical element. On this account a very cautious person might refuse to attempt a theoretical explanation of the experimental results, and his diagram would consist solely of a series of points without any continuous lines, for every experiment shows the state of equilibrium at only a single point. In any case there is no sense in constructing, and it can never be correct to construct, an equilibrium diagram which is contradictory to the laws of heterogeneous equilibria. The question as to how far it is permissible to complete an equilibrium diagram built up on the basis of experimental results by considerations based on theoretical grounds—*e.g.*, on the phase rule—is a very difficult one, as the method of completion is, in many cases, optional, and one must always choose one of the theoretically possible methods, and is not always in the position to say whether other methods are not also applicable. This ambiguity is greater the more numerous are the gaps in, and the more uncertain are, the experimental data. The phase rule has here a similar significance as formal logic in thinking in general. Logic enables one to state whether a complete series of ideas is correct—that is, free from contradiction, and therefore permissible; it does not, however, allow one to state the ideas which are to be linked up. Similarly, the phase rule and the laws of heterogeneous equilibria show whether an equilibrium diagram constructed from experimental results is possible, but not which combinations in general are to be put into effect. It is therefore to be recommended that the hypothetical portions of a diagram—i.e., those parts not confirmed by direct experiment—should be kept as small as possible, and that those parts of the diagram which have not definitely been proved should be pointed out so as not to give the reader a false idea of the accuracy of the work. This is especially important with ternary and quaternary alloy systems where the relationships are particularly complicated.

Although the theoretical bases of equilibrium diagrams can now be considered to be completely stabilised, our experimental methods of investigating alloy systems cannot be said to be in any way perfect. The following facts illustrate this point: in spite of much research, many binary systems have not yet been completely elucidated—for example — the chromium-manganese system, the diagrams of several important systems, *e.g.*, that of copper and tin, which have been frequently investigated, are still being modified in minor details by further research, and, finally, the working out of a

complete diagram to the last detail entails an enormous amount of work. This last point applies particularly to the aluminium-zinc system, which has been the subject of numerous careful researches, and in the early days was productive of many erroneous results. In my own practical experience, especially with antimony-tellurium alloys, I have often found it difficult to construct a satisfactory diagram from theoretical considerations based on the results obtained by the usual methods. Obviously in ternary systems the relationships are still more complex, and I cannot look at a ternary diagram of, for example, certain aluminium alloys without feeling a certain amount of doubt about its accuracy when all parts of the system have not been very carefully explored; in these cases such a diagram loses a great deal of its interest for me. In these complex systems it is much more inadmissible to make constructions which have no theoretical support or are in direct contradiction to theory than to make those which have at least some theoretical basis.

The basis of our knowledge of an alloy system is the "ideal" equilibrium diagram to which alone the laws of heterogeneous equilibria can be applied, and which alone can be controlled and explained theoretically. The so-called "technical" diagram naturally has its uses, as it shows the state of the alloys under practical conditions; but, until the ideal diagram has been definitely established, no certain value can be attached to the technical diagram. This follows from the fact that the deviations from the ideal diagram are dependent on the slowness of the reactions in the alloys, which can vary not only with the different alloys of the series, but also with alteration of the conditions, *e.g.*, of purity. Any unintentional or unnoticed change in the conditions will therefore alter the contour of the technical diagram, and unless the ideal diagram is known it is not possible to attach the correct significance to, or to control, these variations.

Let us first consider the ideal diagram. The most important requirement and the most difficult to fulfil in the study of the constitution of alloys is the attainment of a perfect thermodynamical equilibrium, without which the greatest accuracy in the measurements of the individual properties is useless.

On this account all methods are unsatisfactory which depend on a certain rate of change in the state of the alloy; this excludes, in the first place, all thermal methods, which are, however, of great value in obtaining a preliminary idea of the system, owing to the ease and rapidity with which they can be carried out. In place of these methods modern technique involves measurements of the physical properties, especially the electrical conductivity, at different temperatures. Conductivity measurements were first conducted by Zemzushnii, improved by Honda, and systematically studied by Grube and his students in Germany. The results obtained, we know, are equivalent to those obtained by thermal methods, but conductivity measurements are independent of the rate of cooling, and we can wait before taking a measurement until equilibrium is established at any particular temperature.

In some alloys the resistance to internal change is so great that prolonged heating at a definite temperature does not suffice to bring about a state of equilibrium, and it is generally necessary, therefore, to adopt special means of attaining this state rapidly. One method of effecting this is to subject the alloy to plastic deformation prior to heat-treatment. Another method is that adopted by Genders and Bailey to establish the boundary of the α phase in the copper-tin system. These investigators determined this boundary at low temperatures by quenching the alloy (*e.g.*, that containing 61.5 per cent. of copper) from a temperature at which it consisted of pure β at about 900° C. and then annealing at different lower temperatures. After this treatment the alloy became homogeneous α in one hour. With less efficient quenching, such that small amounts of α crystals were precipitated, a much longer time of heating was required to remove the last traces of β.

The efficiency of the method used by Genders and Bailey depends apparently on the fact that, after the homogeneous β phase has been retained by quenching in a concentration range which is really in the region of α at the lower temperature, the ensuing transformation, $\beta \rightarrow \alpha$, probably can take place without any great change of concentration, and therefore without any appreciable formation of particles of lower copper content, which have subsequently to be absorbed by diffusion. When, however, precipitation of α takes place at higher temperatures, say, 700° C., the α crystals first formed are poorer in zinc than the remainder of the alloy, and hence become surrounded by zinc-rich β crystals, which are subsequently absorbed by the α only with difficulty. The principle of this treatment

can be formulated as follows: When it is desired to cause a transformation to take place from one homogeneous phase to another homogeneous phase of the same comopsition through an intermediate heterobgeneous field, the attainment of equilibrium in the second homogeneous field is greatly accelerated by first stabilising the first homogeneous phase at the lower temperature by quenching.

This procedure is not applicable without modification to other cases—for example, it cannot be used to establish the boundary *cd* of the β phase.

(*To be continued.*)

THE OPEN-AIR CORROSION OF COPPER. A CHEMICAL STUDY OF THE SURFACE PATINA.

By Dr. W. H. J. Vernon, F.I.C., and L. Whitby, M.Sc., A.I.C.

The patina on copper after prolonger exposure to the open air has been studied, samples having been taken from copper structures in urban, rural, and coastal districts respectively. Provided the exposure has been sufficiently prolonged, and in the absence of certain prejudicial circumstances, a pleasing green patina characterises the metal surface in each type of atmosphere. Frequently (in urban districts invariably), the metal passes through a preliminary black stage, the persistence of which is favoured by the presence of lead in the metal and by shielding from wind and rain. In general, the green patina consists essentially of basic copper sulphate. An exception to this is the product from a purely marine atmosphere, in which basic copper chloride predominates; where urban and marine conditions coincide, however, then basic sulphate in the product greatly predominates over basic chloride. Contrary to the general belief, basic copper carbonate enters only to a minor extent into the composition of the product, even in rural districts remote from sea and town. Sulphur, compounds, derived from products of combustion and disseminated by wind, are the most potent agents in the development of patina. The underlying metal, after long periods of exposure, shows remarkable freedom from pitting. With the exception of lead, which tends to accumulate in the product, the impurities usually present in the metal have no appreciable effect on the composition or appearance of the patina.

THE PHYSICAL SOCIETY.

October 25.

Papers read :—

Some Additional Lines in the Secondary Spectrum of Hydrogen. By F. C. Connelly, A.R.C.S., B.Sc., D.I.C.

The author had measured about 1000 lines in the hydrogen spectrum between λ 4735 and λ4018 when the similar work of Gale, Monk and Lee, was published in 1928. The author's list included, however, about 280 lines not given in the prior list.

The Transverse Velocity Gradient Near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established. By E. G. Richardson, B.A., Ph.D., D.Sc., and E. Tyler, M.Sc., F.Inst.P.

A comparison is made of the alternating and direct flow of air near the mouths of tubes of various sections, by traversal of a hot-wire anemometer across the tube. After a correction for the use of the hot wire in the neighbourhood of the walls of the tubes has been made, the theoretical and observed gradients of mean velocity across the sections are compared. The existence of a layer of laminar flow close to the walls, when the main body of air is in turbulent motion, is demonstrated.

Resolving-power Tests on Microscope Objectives Used with Ultra-Violet Radiation. By B. K. Johnson, F.R.M.S.

The work described was conducted with the view of determining the extent to which the increased resolving power which should be obtainable by the use of ultra-violet radiation instead of visible light is realisable with modern microscope object-glasses, computed for use with ultra-violet radiation. The method, which provides a quantitative rather than a qualitative test on an objective, was first developed for visual lenses and has now been adapted for use with ultra-violet objectives. An object of known regular structure and of variable interval is produced by projecting in the object-plane of the lens under test a reduced image of a grating, the apparent line separation of which is varied by rotation of the latterffi thus the line interval can be determined with resolution just ceases. The results show that the fused monochromatic object-glass of numerical aperture 0.85, computed for and used with radiation of wave-length 0.51μ; while the fused quartz monochromatic lens of numerical aperture 1.2 has a resolving power 70 per cent. higher than that of a well-corrected object-glass of the same numerical aperture when used with light of wave-length 0.51μ.

THE FARADAY SOCIETY.

An Ordinary Meeting was held in the Rooms of the Chemical Society, Burlington House, W.1, on Thursday, 31 October. The following paper was read and discussed :—

Volume Changes During Solidification of Metals and Alloys of Low Melting-point. By W. E. GOODRICH, M.Met.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

SEPTEMBER EXAMINATIONS, 1929.—
PASS LIST.

Examination in General Chemistry for the Associateship :—

Bell, James Alfred (Royal Technical College, Salford); Chirnside, Ralph Clark (Rutherford Technical College, and Chelsea Polytechnic); Ellenberg, William (Chelsea Polytechnic); Elwes, Eric Vincent (Central Technical School, Liverpool, and The Technical College, Leeds); Jones, John Mather (Birkbeck College, London); Nutter, Arnold, A.M.C.T. (College of Technology, Manchester); Rattray, Edwin John Thomas (Royal Technical College, Salford, and Central Technical School, Liverpool); Robinson, Edmund Brodie, B.Sc. (Lond.) (University College, Nottingham); Savidge, Leslie Noel (College of Technology, Manchester); Schofield, Harry Fryer, A.M.C.T. (College of Technology, Manchester); Weston, Bernard Allan (West Ham Municipal College, and Birkbeck College, London); Winstanley, Arthur, A.M.C.T. (College of Technology, Manchester).

Examination for the Fellowship :

In Branch E : The Chemistry, including Microscopy, of Food and Drugs, and of Water :

Bunce, Edwin Herbert; Elvidge, Wilfred Farrand, B.Sc. (Lond.); Stern, Isaac, B.Sc. (Lond.); Warren, William, B.Sc. (Lond.); Williams, Hugh Amphlett, A.C.G.F.C.; Wood, Robinson Pearson, M.Sc. (Dun.).

In Branch F : Agricultural Chemistry :

Jones, Daniel Evans, M.Sc. (Wales), F.I.C.

In Branch G : Industrial Chemistry :

Charap, Myer Martin, B.Sc. (Lond.); Taylor, Henry Frankland; Wilshere, Lawrence Arthur, A.C.G.F.C.

In a Special Examination in Refining and Testing of Petroleum and its Products :

Maung, Maung, B.Sc. (Calcutta), A.R.C.S.

THE OPTICAL SOCIETY.

A Meeting was held at the Imperial College of Science and Technology on October 10, the President, Mr. F. Twyman, F.R.S., in the chair.

A paper entitled *The Development of the Telescope*, mostly after documents in the Court Collection (1675-1830), by THOMAS H. COURT and MORITZ VON ROHR, was read by Dr. Clay.

J. Lipperley was the first to construct a practical telescope for military purposes in 1600. This was called the Dutch Telescope. Galileo developed this type and applied it for astronomical purposes. The Capuchin Father v. Schyrle in 1645 printed, in the form of a cryptogram, rules for making a telescope with an erecting eyepiece composed of three collective lenses. Starting from this point the authors trace the development of the telescope in England down to the beginning of the nineteenth century.

Considerable space is given to the invention of the Achromatic Objective. Contrary to the usually accepted views on the point this invention is attributed to Chester Moor Hall, a bencher of the Inner Temple, in the year 1773. Hall kept his invention secret, but it became known, and John Dollond, after independent experiment, patented it. He was awarded the Copley Medal by the Royal Society. Although some of the London Opticians made and sold these glasses, John Dolland never took any action against them. After his death his elder son, Peter Dollond, brought successful actions for infringement against various London Opticians, and in one case was awarded £250 damages. The Judge, Lord Camden, was reported to have said, " It was not the person who locked up his invention in his secretoire that ought to profit by a patent for such invention, but he who brought it forth for the benefit of the public." This decision has often been cited in patent actions. New light has been thrown on this famous invention and on many others by the examination of new documents as well as by the Instruments and documents in the Court Collection.

INSTITUTE OF MECHANICAL ENGINEERS.

At the Annual Dinner in London on 17 October, Lord Thomson, Secretary of State for Air, said reference had been made to publicity, but he had never been very conscious of that publicity except from the

point of view that they had many critics. It was fair to say that 70 per cent. of the publicity of the Air Force, and notably a certain activity of that force, had been entirely due to hostile criticism. The young fellows over whose work he presided led perilous lives. They had this year magnificent opportunities and had been very much in the public eye, but it must not be imagined that the Air Force sought publicity for the sake of publicity. The Air Force was essentially a technical profession, and it was necessary for every member of it to be a highly skilled technician. High courage and extreme skill by their young men was absolutely essential for the efficiency of that force.

Referring to the airship R 101, which he hoped to join that night after leaving them, Lord Thomson said that the only risk he feared was the motor journey to Cardington in the dark. (Laughter.) Mr. Chorlton had been working in with the Air Ministry day by day for months and perhaps years in perfecting those magnificent engines. He was told by experts that the engines had more than surpassed the expectations, and that this country had given a lead to the whole world in using a fuel with a flash point of 215 deg. Fah., which flowed satisfactorily at 1 deg. Fah., which for the same weight gave 25 per cent. more range to the airship, and at a cost of one-fifth of the price of petrol. That was the contribution of British engineers to the solution of the problems of flight, a contribution of incalculable significance to the development of transport throughout the British Empire.

Among those present were :— Lord Crawford of Balcarres, Lord Camrose, Sir John Dewrance, Sir John A. F. Aspinall, Sir Henry Fowler, Admiral of the Fleet Sir Charles E. Madden (First Sea Lord), Engineer Vice-Admiral R. W. Skelton, Dr. H. S. Hele-Shaw, Sir Brodie H. Henderson, Sir Vincent L. Raven, Major-General S. C. Peck, the Dean of Westminster, Mr. W. H. Patchell, Major-General C. D. R. Watts, Sir Robert Hadfield, Sir Joseph E. Petavel, Mr. H. T. Tizard, Mr. H. I. Guy, Mr. Maurice F. G. Wilson, Dr. F. E. Smith, Prof. W. Morgan, Mr. J. Arthur Reavell, Dr. Herbert Levinstein, the Master of the Clockmakers' Company, Vice-Admiral G. R. Mansell, Major-General P. G. Grant, Colonel G. H. Addison, Sir Maurice L. Gwyer, Mr. V. Watlington, Engineer Captain W. Onyon, Lieutenant-Colonel Ernest B. Martin, Lieutenant-Colonel J. Mitchell Moncrieff, Mr. C. S. Shapley, Mr. J. R. Bazin, and Mr. Wesley Lambert.

NOTICES OF BOOKS.

The Extra Pharmacopœia of Martindale and Westcott. Revised by W. HARRISON MARTINDALE, Ph.D., Ph.C., F.C.S. Nineteenth Edition. Vol 2. Pp. xxxviii + 760. London : H. K. Lewis, Gower St., W.C. 1929. Price 22s. 6d.

The first volume of the 19th Edition of Martindale and Westcott's invaluable *Extra Pharmacopœia* appeared in June of last year. It was concerned mainly with drugs and chemicals. The present second volume is largely complementary and refers also to matters of diagnosis, analysis, and assay of *materia medica.*

Chemical, pharmaceutical and medical research has been so very active in the past few years that the authors have had a hard task in compiling a concise, and up-to-date and accurate pharmacopœia of " known, admitted and approved " remedies.

This is perhaps most noticeable in connection with the detailed and extensive information given concerning mineral waters. The Karlsbad Sprudel water is not mentioned, however, nor is the Kysibl (Mattoni) Table water, although the sulphurous Piest'any water is described as are many less important and less well known sources.

The section on Radium will be read at the moment with special interest. In some respects the latest published information has been referred to but no account of its history, extraction and chemistry can be considered complete without reference to Mme. Curie's researches on the Jachymov (St. Joachimsthal) deposits in Czechoslovakia, which were for long the main source of this potent medical aid.

Volume XII of the Kodak Research Laboratories *Abridged Scientific Publications* (1928) contains about forty important contributions over a far wider field than that of photographic science. The first article is by Dr. S. E. Sheppard on " The Electrical Deposition of Rubber." Other subjects which are dealt with include :— Molecular Orientation at the Surface of Solids (A. H. Nietz); Light Filters; Optical Sensitising of Silver Emulsions; Dye Toning and other chemical and physical matters of photographic importance.

Forthcoming Events.

UNIVERSITY COLLEGE OF LONDON.

Monday, November 4, at 2 p.m.—" Cosmography in the XVI Century." A public lecture by Professor L. N. G. Filon, F.R.S.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

MANCHESTER SECTION.

Annual Dinner and Dance.—Members are particularly asked to note that the Section's Annual Dinner and Dance will be held on Saturday, November 2, at "The Manchester Ltd.," Exchange Buildings.

Tickets are 7s. 6d. per head, wines extra.

Please state, where possible, when applying for tickets, if for lady or gentleman.

H. Clayton, *Hon. Sec.*

Friday, November 8.—Meeting to be held in Liverpool. "Some Reminiscences of a Government Laboratory." By Dr. Fox, O.B.E., F.I.C.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Monday, November 4, at 5 p.m.—General Meeting.

KELVIN MEDAL PRESENTATION.

The presentation of the Kelvin Medal, 1929, to M. André Blondel, will take place in the Great Hall of The Institution of Civil Engineers, Great George Street, Westminster, S.W.1., on Tuesday, 5 November, at 5 p.m. Sir Donald Macalister of Tarbert, Bart., K.C.B., Principal and Vice-Chancellor of Glasgow University, will make the presentation. His Excellency, the French Ambassador, will receive the Medal on behalf of M. Blondel, whose health does not permit him to travel to London. Sir Brodie H. Henderson, K.C.M.G., C.B., President of the Institution of Civil Engineers and Chairman of the Award Committee, will take the chair.

MINERALOGICAL SOCIETY.

Tuesday, November 5, at 5.30 p.m.—Anniversary Meeting. Dr. C. E. Tilley: "Scawtite, a New Mineral from Scawt Hill, Co. Antrim." Dr. F. Coles Phillips: "On the Composition Plane of [010]-twins in the Acid Plagioclases." Mr. M. H. Hey: "On the Variation of Optical Properties with Chemical Composition in the Rhodonite-Bustamite Series." Dr. F. Coles Phillips: "A Preliminary Account of Some Mineralogical and Chemical Changes in the Green Bed Group of the Scottish Dalradian on Progressive Metamorphism." Mr. E. Heron-Allen will exhibit a so-called meteorite from Hangchow, Chekiang, China.

SOCIETY OF PUBLIC ANALYSTS.

Wednesday, November 6, at the Chemical Society's Rooms, Burlington House, W.1., at 8 p.m.—The following papers will be read:—"The Grouping of Fatty Oils, with Special Reference to Olive Oil." By E. R. Bolton, F.I.C., and K. A. Williams, B.Sc., A.I.C. "The Heat Resistance Curve: A New Bacteriological Test for Pasteurised Food." By Cuthbert Dukes, M.D., M.Sc., D.P.H. "A New Borax Solubility Test for Lactic Acid or Natural Sour Casein." By W. R. Mummery, F.I.C., and F. Bishop.

NATIONAL SMOKE ABATEMENT SOCIETY.

LECTURES ON SMOKE ABATEMENT.

Friday, November 8.—"Coal and its Combustion." By Andrew McCulloch, M.Sc.Tech, A.I.C.

Friday, November 15.—"Smoke and Health." By John S. Taylor, M.D., D.P.H.

Friday, November 22.—"Smokeless Fuels." By William Gibson, M.Sc.Tech, A.I.C.

All enquiries should be addressed to:—Arnold Marsh, M.Sc.Tech., Secretary, 23, King Street, Manchester.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

30,374.—Bataafsche Petroleum Maatschappij.—Preparation of concentrated formic acid solutions. October 7.

30,908.—Chemieverfahren-Ges. — Production of potassium nitrate. October 11.

30,909.—Chemieverfahren-Ges. — Decomposition of crude phosphate. October 11.

30,910.—Chemieverfahren-Ges. — Production of potassium nitrate. October 11.

30,396.—Govers, F. X. — Process of making diphenyl. October 7.

Specifications Published.

293,316.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of ethers or esters of carbohydrates of the type $C_6H_{10}O_5)x$.

820,072.—Wade, H. (Deutsche Gold-und-Silber-Scheideanstalt vorm. Roessler).—Process for bleaching textiles by means of solutions yielding nascent oxygen.

204,572.—Traube, W. Manufacture and production of valuable products from carbohydrates.

320,129.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges).—Production of concentrated nitric acid from dilute solutions.

820,182.—Jackson, L. Mellersh.—(Mathieson Alkali Works). — Manufacture of calcium hypochlorite.

Abstract Published.

818,067.—Decomposition of silicates. — Blanc, G. A., 3, Piazza Del Popolo, Rome.

Aluminium, ferric, and potassium chlorides.—Ferric chloride is removed from the acid solutions obtained in the treatment of *leucite, or other silicates with hydrochloric* acid as set forth in Specifications 176,770 and 181,677, by allowing the strongly acid mother liquor, from which the aluminium chloride has crystallised while hot, to cool at the end of each operation before diluting the same with water. Ferric chloride is *deposited, together with a portion of the* potassium chloride.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

MONSOON.

503,110.—Formic acid, acetic acid, bisulphite and sulphite of soda, all being chemical substances for use in manufactures.—Planters' Stores & *Agency Company, Limited*, 17, St. Helens' Place, London, E.C.3. October 16.

NEUTRAMMONKA.

505,032.—All goods in class 2, which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Salzbergwerk Neu-Stassfurt, Stassfurt, Germany. October 16.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It *is also intended for use in Schools, where the History of Science occupies a place in the* curriculum.

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TECHNICAL TRANSLATIONS.

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This is an interesting and useful Work, giving in tabloid form Biographical Sketches of Prominent Educationists from the earliest times and in all countries. Mr. Roscoe has written many important books, but none of greater importance in its own sphere than the above Work.

MATTER AND LOGIC.

By DR. W. TOMBROCK.

The Proton. Its Electrical Character. Resumé.

In our discussion of "The Proton as a Source of Force" (*Chem. News*, this Vol., p. 241), we have already remarked that the cyclonic rotatory behaviour of a proton, considered as a complex material unit, acts like a mechanism giving the explanation of the *apparent* attractive or suctional force situated at the centre of the cyclone. This representation therefore covers the attraction which according to the customary idea, the proton as a unit of positive electricity exerts on the electron. . . The question now arises:— Can we according to our ideas also find a representation which will cover a possible discharge of the proton (transformation into a hydrogen atom when we are dealing with a separate proton)?

In our original discussions on the proton as a *simple* material unit, we premised that it would be greater than the mean size of the other material particles, greater thus than the mean size of an electron. Now that we consider the proton to be a complex unit, however, it is reasonable to suppose that the constituent particles of this ether-whirl belong to the class of the smallest ether-particles. The particles which can function as electrons would thus in size stand *higher* than the mean. In this respect the rôles of the proton and the electron would thus be just reversed, although it is obvious to consider the *total* size of the particles constituting the proton as much larger than that of an electron.

How must we now represent an electrical discharge of the proton?

Certainly *not* in the removal of the cyclonic character; by means of this character we indeed also explain the action which reminds us of a gravitational force and this action also remains after discharge.

How then?

The occurrence of the (apparent) attractive or suctional force of the proton must be very closely connected with its traversability. If thus we can conceive something whereby the traversability of the proton for a larger material particle (electron) is removed, then the customary representation of the electrical discharge will have been covered.

I allow that this problem is difficult and the solution forms a more speculative hypothesis than we have so far been obliged to assume. The solution is namely this:

diminished traversability for larger particles can *perhaps* be explained by a more compact, denser composition of the cyclonic centre in the case of a single proton (H nucleus), by the filling up or obstruction of definite paths of motion or easy thoroughfares in the case of more complicated atoms. The simplest representation is then that the proton becomes discharged when an electron remains attached on its passage through the centre, thus becomes a rotation nucleus and hereby obstructs the passage of a subsequent electron.

Charging whereby the transition from atom to nucleus occurs would then have to proceed in the opposite direction, thus by the ejection of the electron which was functioning as a rotation nucleus or in more complicated atoms by the freeing of certain paths of motion.

I suppose that more than one reader will here remark that we have not then been fortunate with our terms positive and negative for charge; a positively charged proton appears more negative than a discharged proton, and that the opposite nomenclature, the electron positive and the proton negative would be more suitable . . . the remark is just. But I have not been able to notice anywhere that the use of the terms positively and negatively electrical rests on anything else than an accidental and arbitrary denomination for the purpose of distinction in electrical phenomena.

Resumé.

The singular point is, however, that by regarding the proton as an ether-whirl we *firstly* find a mechanical explanation of an apparent attractive or suctional force towards the centre of the cyclonic motion and *secondly* get an acceptable or at any rate understandable explanation of the apparent electrical attraction between a proton and an electron and furthermore a mechanical interpretation also of the discharge of a proton by an electron. And in all this and that is the most important point, a perfectly understandable mechanical explanation also for what we may call the *vis ultima* of matter, whereby force "*qua talis*" quite disappears as a reality and becomes arbitrary and purely imaginary . . . it is simply an accessory to the imagination. That which we retain as reality are merely the moving and colliding material particles . . . the primeval atoms of Democritus with the movement of Thales and the forces of Empedocles freed from unreality and explained. . .

So that in seeking a mechanism which in the atom gives a reasonable explanation of material properties and phenomena, we found a plausible and completely understandable explanation of the electrical behaviour of the proton and the electron, such as that which is assumed in the customary conception . . . an explanation which could not at all have been expected directly. But there is more, the twofold character of light phenomena fit very well with our atomic mechanism and material ether and last but not least whilst all manifestations of force are traced to the same source, *the proton*, a very clear, very acceptable representation of the mechanism of gravitational phenomena also makes its appearance.

It is mainly our conception of the proton as a *complex* material unit, as an ether-whirl, at which we arrived when we sought for a plausible explanation of cosmic (Millikan) rays, which has enlightened and strengthened our whole system of a logical interpretation of the mechanical part of purely material natural phenomena.

By this means is "Atomic Electricity Explained and Explained Away" (see *Chem. News*, 1928) . . . in reality there exists no electrical attraction in the atom, a real gravitational force exists just as little, only moving and colliding material particles exist, which, when the circumstances are favourable for it, produce effects which call forth the idea "force" for the purpose of clearing or explaining what we have pictured the whole to be. Thus by the action of the ether-whirls, which we call protons, there is produced an effect which we attempt to elucidate and explain by the action of a supposed gravitation, which does not, however, exist in reality.

The gravitational force exists only apparently unless . . .

Unless one would see in the effect of a collision between two material particles the action of one or more real forces; then one could in a certain sense conceive gravitation and other forces as the resultant of the forces above mentioned, which play a part in the collision. But these forces, although one may conceive them as real, are then however *passive* in any case; they do *not* produce the collisions but are called forth themselves by them . . . the collisions of the moving particles are here the primary thing, we should not have in any case as the primary thing a gravitational force which would direct the motions of the particles and thus would cause the collisions, but it is for us with *our* atomic mechanism exactly the

opposite; the moving material particles by their collisions produce an effect which one believes one can explain by the action of a gravitational force. It is *as if* gravitation causes an object to fall, in reality, with our atomic mechanism, it is the protons, the ether-whirls which cause this motion. When we lift a stone then through the action of thousands of millions of protons it is *as if* a force chains it to the earth. If we let the stone fall then it moves like a structureless aeroplane with thousands of millions of propellors, which follows the line of the least resistance. This direction is that of the *supposed* gravitational force. If one would thus explain the effect of a collision between two material particles by the action of one or more forces, and call these forces real, then one can indeed also consider gravitational force as a reality but in any case it remains *passive* and one arrives at something which much resembles a "*contradictio in terminis*" a "passive agent." And this latter makes *me* decide either *not* to ascribe the effect of a collision to the action of one or more forces or to consider these forces as completely arbitrary and imaginary.

It thus appears to be quite possible that through the action of cyclonic protons, *gravitational force, qua talis, as actively* directing the motion, can be excluded and thus need *not* be assumed.

And the noteworthy result to which our discussions have led us, given in a more general form, is this :— *Our knowledge of natural phenomena can be fundamentally explained by means of the motion of particles which cannot simultaneously occupy the same place and among which protons function as complex material-units in a cyclonic form of motion.* As a result, active, motion-directing "forces" would be unnecessary.

Whoever would, however, assume that *resistance-forces* occur in a collision of two material particles, is at liberty to deduce from these resistance-forces *all* other forces which play a part in physics and chemistry.

Bergen op Zoom,
Holland.
October, 1929.

In the *Collection of Czechoslovak Chemical Communications* for October, 1929, J. V. Dubsky and A. Rabas publish a paper on the Additive Compounds of Organic Bases with the Salts of Heavy Metals. Well defined compounds with zinc chloride, and copper sulphate were obtained.

THE HEAT TREATMENT OF STEEL.

Low Temperature Carbonisation and Gaseous Fuel Firing.

By A Well-Known Engineer.

One important general application for the low temperature carbonisation of coal is in the iron and steel and general metallurgical industries, treating bituminous coal dust and smalls to obtain smokeless solid fuel in large pieces, equal in quality to screened coal, as well as tar and light oil, and using all the clean rich gas direct for the heat treatment of steel. At the present time the general method adopted is of course hot uncleaned producer gas, but there is also employed coal or other solid fuel in the lump form, pulverised coal, oil, natural gas, and coke oven gas. In this connection a highly interesting paper: "Fuel Used in Heat Treatment of Steel" has been read in Philadelphia by Martin J. Conway, Fuel Engineer to the Lukens Steel Company, Coatesville, Pa., well known for boiler plates and flange steel, who are going to take all the gas, as already mentioned in these columns, from a "K.S.G." low temperature carbonisation plant. Mr. Conway sums up the advantages of low temperature carbonisation gas as against hot uncleaned producer gas as follows :— (1) Cleaner operating conditions without soot and deposits in the gas mains, and entire absence of ash and clinker; (2) Constant calorific value of the gas, which does not obtain with producers, especially because of the necessity of clinkering; (3) Ease of control, due both to constant pressure and calorific values, thus allowing of highly efficient automatic gas supply with constant heat; (4) Flexibility in the sense that low temperature carbonisation gas of this character can be piped with the greatest ease to any part of the plant whereas hot dirty producer gas cannot be sent for long distances and the supply pipes lined inside with firebrick are costly to instal and also keep in operation; (5) Great accuracy in the actual heat treatment of the steel in the sense that the flame can be altered instantly so as to give a slightly reducing or slightly oxidising atmosphere at will, with continuous maintenance of these conditions in a manner impossible with producer gas or oil firing; (6) Various other advantages which include easy metering of the gas and therefore very scientific control of the furnace operation while it is not necessary to pass the gas through regenerator chambers, so that the whole of the regenerator equipment can be thrown on to pre-heating the air and giving still higher combustion efficiency.

It may be remembered that the "K.S.G." plant now being erected by International Combustion Engineering Corporation adjoining the Lukens Steel Works, consists of six *standard rotary cylindrical steel retorts*, each with a throughput of 80 tons of coal per 24 hours, that is 480 tons for the complete plant. These retorts are very large slightly inclined steel cylinders, 85 feet long and 5 feet 6 inches diameter, carrying an outer cylinder 72 feet 9 inches long and 10 feet diameter, running at one revolution in 90 seconds, driven by suitable gearing and giving 2¼ hours' carbonisation with a maximum temperature of 925°-1025° F. by means of *external heating along with steaming* of the charge, and blending if necessary with a small amount of the smokeless fuel smalls. Obviously the future of low temperature carbonisation, and especially in Great Britain, lies in co-operation with furnace equipment, using all the gas, for example, in steam boiler plant, and pottery, general ceramic and glass works, as well as, of course, in the iron and steel and general metallurgical industries.

THE SEPARATION OF THE ELEMENTS OF THE PLATINUM GROUP AND THEIR ALLIES.

By Isaburo Wada and Shoichiro Saito.

Among the various elements which may be precipitated by means of hydrogen sulphide from acid solutions of their compounds, some are separable before the solutions are treated with this reagent in the course of analysis, and others, which are usually treated with the same reagent, are not always alike in their behaviour towards the reagent. The former have been left out of the present investigation. The latter have been examined in order to see whether they can be grouped according to their behaviour towards the reagent, and whether subsequent analytical processes can be made simpler by any group separation.

Experiments have shown that the metal sulphides may be divided into three sub-groups: namely, A, comprising the elements Sb, Bi, Cd, Cu, Au, Pb, Hg, Pd and Te, which are precipitated easily and completely from cold weakly acidic solutions; B, comprising Ir, Rh, and Ru, which are precipitated completely from hot strongly acidic solutions; and C, comprising Mo and Pt, which resemble B and A in some respects. Experiments have also shown that when the elements of the sub-group B are present in considerable quantities with those of the sub-Group A, a small fraction of the former will precipitate together with the latter from the cold weakly acidic solution, but this small quantity can be extracted by means of the same reagent and may be united with the main part of the same elements. Thus *an original mixture containing* the elements of all the sub-groups is separable into two parts: namely, A′ consisting of the elements of the sub-group A, and B′ consisting of the elements of the sub-group B, both of which are accompanied by the elements of the sub-group C. This method of separating all the elements into sub-groups, and subsequent procedures for the analyses of the sub-groups have also been studied experimentally.

THE INFLUENCE OF VITAMIN D UPON VITAMIN A.

By Mizuho Sumi.

It might be naturally conjectured that vitamin D separated from vitamin A will have a growth-promoting effect like vitamin A in a limited sense, besides its antirachitic effect. Moreover, the recent report of the studies made by H. Euler and his co-workers has stimulated deep interest in the same subject. The present author has undertaken a series of comparative experiments on growth-promoting effects of vitmain A and *vitamin A mixed with vitamin D* which was represented by ergosterin irradiated by ultra-violet rays.

As a result of these experiments, it was found that vitamin A supplemented by vitamin D had always a better effect in promoting growth of animals than vitamin A without D, without relation to the quantity of the former supplied.

From this it seems evident that vitamin D bears a close relation to the growth-promoting effect of vitamin A, so that it becomes necessary to consider more seriously the influence of vitamin D mixed with vitamin A, whenever one proceeds to make such a quantitative experiment of the latter with animals.

ANNUAL CONGRESS OF BRITISH INSTITUTE OF RADIOLOGY.

The Department of Overseas Trade is informed that the Annual Congress of the British Institute of Radiology, incorporated with the Rontgen Society, will be held at the Central Hall, Westminster, on 4, 5 and 6 December. A trade exhibition of X-ray apparatus will be held in connection with the Congress, and the Sylvanus Thompson and Mackenzie Davidson Memorial and other lectures will be given in the Congress Hall adjoining.

THERMOELECTRIC TEMPERATURE SCALES.

By WM. F. ROESER.

(*U. S. Bureau of Standards.*)

The International Temperature Scale, adopted in 1927 by the Seventh General Conference of Weights and Measures, representing 31 nations, is the fourth thermoelectric temperature scale used by the Bureau of Standards since 1912. In putting this scale into use it was necessary for the Bureau of Standards to replace all of the fixed points used previous to 1926 by new fixed points specified in the International Temperature Scale. It is the purpose of this work to determine how much change this has caused in the temperature scale and to make available comparisons between the various scales used by the Bureau of Standards at different times since 1912.

The difference between four thermoelectric temperature scales based upon (1) Sb, Ag, and Au; (2) Zn, Al, and Cu; and (4) Zn, Sb, and Cu as calibration points have been determined. The maximum difference between (1) and (2) was found to be 0.1° C., between (1) and (3) 0.2° C., and between (1) and (4) 0.3° C. in the temperature range 660° to 1,063° C.

The freeezing point of the copper-silver eutectic alloy, 71.9 per cent. silver and 28.1 per cent. copper, on the International Temperature Scale was found to be 779.4° ± 0.1° C.

The difference between the freezing points of gold and copper was found to be 20.0° C. ± 0.1° C.

Methods used at the Bureau of Standards in realising the International Temperature Scale in the range 660° to 1,063° C. have been investigated.

GENERAL NOTES.

BRITISH STANDARD PHOSPHOR BRONZE BARS OR RODS.

A specification for phosphor bronze bars or rods has recently been issued by the British Engineering Standards Association. This specification is drawn up on parallel lines to the specification for brass bars published in 1926, and covers round, square, and rectangular bars from ¼ in. to 2 in., and hexagon bars for standard nuts from No. 8 B.A. to 1¼ in. B.S.W. and 1⅛ in. B.S.F., with specified margins of manufacture. The chemical composition of the material, mechanical tests, and the procedure of selecting samples for these tests are laid down.

FERTILISER MANUFACTURE IN CANADA.

The utilisation of fertilisers in Canada has not hitherto been carried on so thoroughly as is common in many older countries. Nevertheless, much attention is being given to the matter and one important metallurgical plant in British Columbia is finding it advantageous to spend many millions of dollars on the establishment of a plant for the utilisation of by-product sulphuric acid in conjunction with local phosphate deposits and to produce therefrom superphosphate fertilisers for distribution on the prairies. This plant will not be in operation for some time yet, but the production of complete fertilisers in Canada in 1928 reached a total value of $2,189,986. This total is additional to the output of $7,951,502 representing fertiliser materials such as calcium cyanamide, ammonium sulphate, animal tankage, ground bone and fish fertilisers.

Only 12 plants in Canada produced complete fertilisers as their major product during 1928; 5 were in Ontario, 2 in Nova Scotia, 3 in British Colnmbia, and 1 in Quebec and 1 in New Brunswick. Capital employed in these plants amounted to $2,121,905 and the average number of persons employed the year round was 251. Payments in salaries and wages totalled $281,109 and materials used in manufacture cost $1,446,800.

Complete fertiliser was the major product of the industry. In 1928, production amounted to 53,799 tons worth $1,990,830, or 90 per cent. of the total output of the industry. Superphosphate was actually made in only one plant although several other manufacturers of complete fertiliser sold quantities of superphosphate after dilution with a filler to meet the requirements of the trade. One concern was engaged solely in grinding and preparing basic slag.

Production of complete fertiliser by firms in other industries amounted to 20,881 tons worth $944,818, while ammonium sulphate, cyanamide, animal tankage, fish fertiliser, and ground bone, used extensively, were also produced by concerns classified in other industries.

Imports of fertilisers and fertiliser materials during the calendar year 1928 amounted in value to $5,019,841. This total included superphosphate, manufactured fertilisers, sodium nitrate, muriate and sulphate of potash, basic slag, and ammonium sulphate. Exports, valued at $5,370,886 included cyanamide, ammonium sulphate and manufactured fertilisers.

THE COPPER SITUATION IN CANADA.

The first recorded production of copper in Canada was in 1886. British Columbia has been for many years the principal source of production but Ontario has also contributed substantially and within a few years should become the largest copper producing Province in Canada. Quebec, which had formerly been producing at the rate of about 1,000 tons a year, produced 17,000 tons in 1928, or 16 per cent. of the total output. Ontario in 1928 contributed over 32 per cent., and British Columbia 50 per cent. of the total.

The Canadian output of copper has gradually increased from 1,752 tons in 1886 to 4,696 tons in 1896; 27,805 tons in 1906; 58,575 tons in 1916; 66,547 tons in 1926 and 101,348 tons in 1928. For the first six months of 1929 the output amounted to 57,800 tons; an increase of about 24 per cent. over the quantity production for the same period in 1928. At this rate the output for 1929 should reach about 120,000 tons.

By the end of 1930 Canada should be producing copper at the rate of about 160,000 tons a year. Of this it is estimated that British Columbia will produce about 60,000 tons; Ontario 50,000; Quebec 35,000, and Manitoba 15,000 tons. The end of 1931 should see a still larger output. The new refinery at Copper Cliff will have a yearly capacity of 120,000 tons of refined copper, a large proportion of which will be obtained from the treatment of the high grade ore from the Frood mine.

World production, which is mainly based on the blister copper output, amounted in 1928 to 1,883,431 tons, of which Canada contributed about 5 per cent. World production for the first six months of 1929 was 1,102,700 tons. The consumption of copper in Canada during 1928, including manufactures, has been estimated at 37,000 tons, of which about 9,000 tons of refined copper were produced in the Dominion.

The construction of the new copper refinery at Copper Cliff, Ontario, is progressing rapidly. The foundations are about completed and the steel structure is expected to be completed by mid-winter. This plant will be operated by Ontario Refining Company in which are associated International Nickel, Consolidated Mining and Smelting, and the American Metal Company. It will have an initial monthly capacity of 10,000 tons of refined copper.

The Horne Copper Corporation is proceeding with the completion of the second 1,000-ton unit of their smelter at Noranda, Quebec, which will bring the yearly capacity of this plant to 35,000 tons of blister copper. It is expected that construction will soon start on the proposed refinery of the Canadian Copper Refineries, Limited, a subsidiary of the Horne Company to be located in the province of Quebec.

The erection of the copper smelter at Flin Flon, Manitoba, by the Hudson Bay Mining and Smelting Company is proceeding satisfactorily and the new plant is expected to be in operation by the end of 1930. It will have an initial yearly capacity of 15,000 tons of blister copper.

In British Columbia the concentrators at Allenby, Britannia Beach, and Anyox, and the Anyox smelter of the Granby Consolidated Mining, Smelting and Power Company, have been operating at full capacity. It is understood that the Consolidated Mining and Smelting Company is seriously considering the erection of a copper smelter and possibly a refinery on the Pacific Coast. Na definite statement, however, has yet been made in this respect by the Company.

HEALTHY GAS WORKERS.

Contrary to the general belief that employment in gas-works is both dirty and dangerous, the *Co-partnership Journal* of the South Metropolitan Gas Company in its current issue points out that it is, in reality, one of the most healthy of industrial occupations.

"From a total of 9,320 industrial workers admitted to the Edinburgh Royal Infirmary," says the Journal, "only thirty-three came from the ranks of gas workers. Among all other spheres of labour represented in the wards, missionaries and ministers, soldiers and musicians alone showed a lower sickness rate. Further, investigation last year by the Australian Government into the health o employees in gas making plants showed that 90 per cent. of the men were either of average physical condition or above it, and the average length of service for all occupations was over twelve years, while in many individual cases periods of from thirty to forty years were recorded."

Comparison of the lists of retirements and deaths among the seven thousand co-partner employees on the pay roll of the South Metropolitan Gas Company, strengthens the view that the manufacture of gas is a healthy occupation. The figures published each month in the *Co-partnership Journal* show that, on an average, the proportion of retirements to deaths is three to one.

NATIONAL MARK MALT PRODUCTS.

In spite of its unrivalled excellence, there has been a steady decline in recent years in the demand for and production of home-grown barley. With a view to strengthening the position of English barley in the home market, the Minister of Agriculture and Fisheries has made draft regulations* under the Agricultural Produce (Grading and Marking) Act, 1928, prescribing and defining grade designations and grade designation marks for voluntary use in connection with the manufacture and sale of malt flour and malt extracts made entirely from home-grown grain.

It is intended that a scheme to carry these regulations into effect shall come into operation on the 1 December next. The regulations prescribe two grades of all-English malt flour for use in baking white and brown bread respectively and four grades of all-English malt extract, namely, "Pharmaceutical," "Bakers (white bread)," "Bakers (brown bread)," and "Veterinary." These grades will be associated with the National Mark, which will be applied to the packages in which the malt flour and malt extract respectively are contained. The regulations require that only home-grown barley or malt may be used in the manufacture of these products and that a high standard of quality shall be observed. The scheme is supported by the Association of Malt Products Manufacturers.

In every grade of malt flour and malt extract there is a defined standard of diastatic power; other factors also are prescribed, such as the protein content and specific gravity of extracts, and the moisture or fibre content of the flour. National Mark all-English malt products should accordingly commend themselves to the medical profession, to bakers and pharmaceutical chemists and to others who require products manufactured to precise standards.

All-English pharmaceutical malt extract, with or without cod liver oil, will be available for retail sale under the National Mark, and in regard to the cod liver oil that is used, fixed quantitative and qualitative standards will also be laid down. Buyers of National Mark pharmaceutical malt extract for ordinary family use will find it to be of the finest and most nutritive quality obtainable.

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* Agricultural Produce (Grading and Marking) (Malt Flour and Malt Extract) Regulations, 1929.

SPANISH COUNCIL OF ELECTRIC ENERGY.

The British Commercial Secretary at Madrid has furnished a translation of Decree-Law No. 1956 of 7 September, 1929, under which a Council of Electric Energy, working under the Spanish Ministry of Public Works, is established. The duty of the Council is to investigate and co-ordinate hydro-electric schemes.

The Decree-Law does not apply to concessions already granted, but makes provision, in general, for State control of future developments of electric energy in Spain.

A translation of the Decree-Law may be consulted at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

FUEL RESEARCH.

The Department of Scientific and Industrial Research announces the issue of the Report of the Fuel Research Board for the year ended 31 March, 1929. With it is included the Report of the Director of Fuel Research, and the publication, which contains 130 pp., with 13 text figs. and 5 plates, may be obtained from H.M. Stationery Office, price 2s. net.

In particular the main Report contains, in addition to the usual progress report :—

A restatement of the objects of the Physical and Chemical Survey of the National Coal Resources, its organisation and methods of working, together with notes on some of the results having immediate practical application.

A summary of the methods in use for the examination of coal, and a comparison of the various methods at present available for the determination in the laboratory of the coking qualities of coal.

A summary of an extensive investigation into the effect, in both vertical and horizontal gas retorts, of grading the coal as to size before carbonisation.

Some notes on the method of heating horizontal gas retorts.

A general review of the present position of low temperature carbonisation.

A discussion of laboratory tests available for the examination of coke.

A description of methods for obtaining a true average sample of gas.

The Director's Report also gives a fuller description than usual of some of the aspects of the work carried out during the last few years, and includes details of a number of minor results obtained.

JAPANESE ADVANCES IN CHEMICAL SCIENCE.

Readers of *The Chemical News* will have been aware of the great activity in Japan in all the branches of chemical science, not only from the references to publication and to papers communicated to societies but also from the steady number of original communications published by Japanese scientists.

The various universities and research laboratories continue their investigations over a wide range of problems in both pure and applied chemistry.

The composition and properties of Japanese coal and its distillation products, the chemistry of silk, industrial oils, the soya bean, and the examination and utilisation of minerals are among the number of industrial chemical problems engaging the attention of Japanese chemists.

In pure chemistry there is much being done in inorganic, organic, biological, and physical chemistry.

The study of fats, soaps and glycols; sulphonation of oils; catalytic hydrogenation; inversion of sucrose and synthesis of carbohydrates; the utilisation of micro-organisms in fermentation processes and the formation of sterols are subjects receiving the attention of organic and bio-chemists.

The chemistry of portland cement; the changes in commercial superphosphate on storing; the adsorption powers of acid clays; transition points in solutions of salts with water of crystallisation, and the mapping of spectra are among the problems engaging the attention of Japanese inorganic and physical chemists.

ANGLO-RUSSIAN RELATIONS.

The Anglo-Russian Committee on the British Trade Delegation to Russia last March has issued an important *Report* (obtainable from 4, Lloyd's Avenue, E.C.3., price 2s. 6d.) dealing with the visit to Russia with a view to opening up fresh trade facilities with that country.

It is pointed out that Russia is potentially a very rich country and at the moment industrial reorganisation is being carried out as far as the limits of the country's financial capacity permits. Another matter to which attention may be directed is that British exports to Russia received a serious set-back through the "Arcos Raid," after which the exports dropped from £20,000,000 in 1925-6 to £5,000,000 in 1927-8, the bulk of Russia's imports of machinery, etc., having since been from Germany.

CORROSION-RESISTING STEELS.

Dr. W. H. Hatfield, of the Brown-Firth research laboratories, Sheffield, lecturing to the Institution of Civil Engineers on October 25, said that research work had resulted in the development of highly corrosion-resisting steels by which Sheffield had once more given a lead to the world.

The production of this steel had made possible the recent great expansion of the chemical industry, for it was now being utilised with great success in the biggest chemical works, not only of Great Britain, but of the world, because of its proved acid-resisting qualities. The technology of these special steels had now been brought to such a high state of efficiency, and the economic aspects were so completely in hand, that there must inevitably be a vast extension of their use. We were only at the beginning of the era of rust and acid resisting steels.

NEW OIL WELL IN CANADA.

Another big strike of natural gas and naphtha has been made in the Turner Valley oil field, southwest of Calgary, Alberta. The new producer is a well drilled for the Associated Gas and Oil Company in the neighbourhood of the Home Oil Company, and it "came in" on September 21 with a big flow of wet gas.

A measurement of the flow on the following day indicated a rate of production of 27,000,000 cubic feet of very wet gas daily. At its present rate of flow the well is considered to be capable of producing 700 barrels or more of naphtha per day.

QUARTZ.

The production of quartz (silica) last year totalled 282,522 tons valued at $523,983, as compared with 233,984 tons, valued at $496,364, delivered from Canadian deposits in 1927. Output during the first half of 1929 totalled 120,423 tons, valued at $210,831, as compared with 99,845 tons valued at $221,845 during the corresponding months of 1928.

THE GOLD FIELDS OF NOVA SCOTIA.

The Geological Survey Branch of the Dominion Department of Mines at Ottawa, has just published a Memoir by Dr. Wyatt Malcolm, dealing with the gold fields of Nova Scotia, this work being compiled largely from the results of investigations by Dr. E. R. Faribault.

The revival of operations in many of the abandoned gold mining areas in Nova Scotia has resulted in a demand for information

relative to the geology of that Province, and the Survey has therefore found it necessary to bring together much information prepared by Dr. Faribault some years ago. Dr. Faribault has spent many years in studying the various deposits described in the Memoir, which is a book of 258 pages, accompanied by a number of new geological maps and abundantly illustrated by photographs.

Gold was discovered in Nova Scotia nearly 70 years ago, and many partial reports have been written on the geology of the Province. The present volume is the first report which makes any claim to completeness. The gold deposits are found in an area about 275 miles long, with a width varying from 10 miles in the east to 40 miles and 75 miles at various points, the larger width being at the western end. It has an estimated extent of 10,250 square miles—about half of the area of the Province. Mining has been carried on continuously for nearly 70 years and although operations have been suspended in numerous districts, work has never wholly ceased. Up-to-date systems of mining and recovery have been worked out in other gold mining areas, and it has been thought that the application of these processes in Nova Scotia may lead to profitable operations where these were not possible by the old methods.

Copies of the Report may be obtained by persons interested on application either to the Geological Survey Branch of the Department of Mines at Ottawa, or to the Office of the High Commissioner of Canada, The Canadian Building, Trafalgar Square, London, S.W.1.

CANADA'S NICKEL-COPPER INDUSTRY.

The Dominion Bureau of Statistics at Ottawa has just issued its final figures relative to the production in 1928 of the Canadian nickel-copper mining, smelting and refining industries.

As has already been reported, mining, smelting and refining of the Sudbury ores showed a great improvement last year as compared with the 1927 figures. More ore was treated by the smelters and as a consequence more matte was produced, and a larger output of refinery products attained than ever before.

The nickel-copper industry was in 1928 carried on in the Sudbury district by four firms operating eight mines, two smelters and one refinery, having a total capital investment of $76,605,559 and employing 4,113 persons whose salaries and wages aggregated $6,668,519, producing matte and refinery products valued at $82,494,359.

The Creighton mine and the smelter at Coppercliff, Ontario, were operated continuously throughout the year by the International Nickel Company, Limited, and facilities for the production of electrolytic nickel at the Port Colborne refinery were increased by the installation of a second electrolytic unit in September ,a third in December, 1928, and a fourth in February, 1929. In addition to electrolytic nickel, this refinery produces refined nickel, nickel oxide, metals of the platinum group and converter copper, carrying gold and silver, which is exported to th United States for refining. Bessemer matte is shipped directly from the smelter at Copppercliff to Huntington, West Virginia, U.S.A., for the manufacture of monel metal.

The Mond Nickel Company, Limited, operated the Garson, Levack, and Frood extension mines, the smelter at Coniston and utilised the Bessemer gases for the manufacture of high-grade sulphuric acid. Matte from Coniston was sent to Clydach, Wales, where pure nickel, copper sulphate, gold, silver, and metals of the platinum group were recovered.

Apart from the actual production from the older properties of the district, development on the International and Mond sections of the Frood mine, were so encouraging and showed so much ore of high copper content that it was deemed advisable towards the end of 1928 to merge the two companies. On the completion of the merger, ownership and control of this large ore body passed into the hands of a single powerful organisation splendidly equipped to operate the property in a highly efficient manner and to market the products to the best possible advantage. In addition to the operations of the Mond and International Nickel Companies, the Falconbridge Nickel Mines, Ltd., acquired a large acreage in the nickel area of the Sudbury district and started development work in September, 1928. The first unit of a smelter plant which will have a capacity of 200 tons daily is now in the course of construction.

The McVittio Graham Mines, Limited, also began development on some properties in this district in the fall of 1928.

OPENINGS FOR BRITISH TRADE.

Calls for tenders are invited from Australia, British India, New Zealand, South Africa, Egypt, Turkey, Portuguese East Africa, Argentine and Chile, and publicity is also given to requests from all parts of the world for agencies for British goods.

DR. EDWIN DELLER APPOINTED PRINCIPAL OF LONDON UNIVERSITY.

Dr. Deller has been connected with the University nearly all his life. He was a law student, taking first the LL.B. with honours, and later the LL.D. In the pursuit of these studies he was a student of University College, King's College, and the London School of Economics. He entered the administrative service of the University in 1912. After his war service he spent a year as assistant secretary to the Royal Society, but was invited to return to South Kensington in 1921 as Academic Registrar. While holding that post he has, during the illness of the late Principal, Dr. Sibly (now Vice-Chancellor of Reading University), acted for eight or nine months as Principal. He thus brings to his responsibilities an intimate knowledge of every side of the University and actual experience of his new task; he brings what is even more important, the respect and liking of all who have worked with him.

The University is to be congratulated on having itself trained and found a man by common consent so well fitted to act as its principal executive officer, and Dr. Deller is to be congratulated on having reached this important office at an age when he is young enough to have energy, imagination, and enthusiasm equal to the very exacting calls that it will make upon him. The University is on the threshold of changes and developments of lasting importance. If only to mention one thing, the affairs of the Bloomsbury site are pressing, and they are intricate and difficult. But there is also, of course, much work to be done in getting the new machinery created by the revised statutes under way.

ESTATE OF SIR RAY LANKESTER.

Sir Edwin Ray Lankester, K.C.B., LL.D., D.Sc., F.R.S., of Oakley Street, Chelsea, S.W., zoologist, formerly Professor of Natural History in the University of Edinburgh, afterwards Professor of Comparative Anatomy at Oxford, who died on August 15, aged 82, left estate of the gross value of £4,612, with net personalty £184. He left £500 to his housekeeper, Matilda Pearson, if still in his service, and £50 to his servant, Violet Mills, if still in his service and not under notice either given or received.

Proceedings and Notices of Societies

THE INSTITUTE OF METALS.

Methods of Research in Metallography. By Dr. G. Masing.

Dusseldorf Meeting, September 9-12.

(Continued from page 284.)

An alternative method has been employed in the Research Laboratory of Siemens und Halske for the investigation of systems containing a solid solution field which becomes narrower with fall of temperature, and has been used satisfactorily for determining the boundary of the α phase in the beryllium-copper system. This method comprises the determination of the electrical conductivity of different beryllium-copper alloys after various thermal treatments.

This is a further application of the principlt, on which Genders and Bailey based their work, of starting with an alloy which is as far as possible from a state of equilibrium. This method can be described in general terms as follows: To find the limits of a homogeneous region in the equilibrium diagram a suitable property of the alloy is mtasured first when the alloy is in the homogeneous, partly supersaturated, solid solution state, then after annealing to cause the excess solute to separate, care being taken that in the first case the composition is not too near that of the saturated solid solution at the temperature of the measurement. In this way, by a suitable selection of the property to be measured, the limiting concentration of the homogeneous region can be ascertained quickly and accurately.

It is obviously essential that in order to use this method the curve of the property under examination should show the sharpest possible deflection at the point corresponding with the limit of solid solubility. In many cases the conductivity curve fulfils this condition, but in other cases, especially where the solid solubility of the added metal is high, another property—*e.g.*, the density, the thermal dilatation which with accurate measurements gives good results, or the lattice constant, must be studied. Glocker has found the last-named method to be valuable in certain cases.

A second essential for the use of this method is an apprpoximate knowledge of the effect of the presence of a mixture of two phases on the values of the property investigated. In the case of the electrical conductivity the values for mixtures are approximately linearly proportional to the

composition, but deviations from this rule frequently occur when th second phase is precipitated in a highly dispersed form during ageing, and care must therefore be taken to see that this does not occur during the taking of the required measurements.

In the preceding discussion only a few devices have been considered which can be used to overcome the difficulties of investigating the constitution of alloys that are slow to attain a state of equilibrium. The problem cannot yet be said to have been attacked systematically, and there is a pressing need for further research with a view to improving and extending the constitution of alloys in general. Again, we have up to the present only an indirect method of identifying the individual types of crystals in alloys and determining their composition, and this uncertainty has led to many erroneous conclusions. A reliable method of characterising tbe crystals in alloys is therefore an urgent need of metallography. So far the most important method in use for this work is X-ray examination, which has also helped to establish the constitution of alloys. A great advance would be made if röntgenographic methods could be used for following the changes which take place continuously in an alloy during cooling so as to establish immediately the lattice structure at any temperature, but, in order to do this, the technique must be improved so that photographs can be obtained much more rapidly than it the case to-day.

Besides the establishment of the equilibrium diagram there is another problem in connection with alloys which has already been occasionally treated and which requires to-day more and more a systematical investigation—that is, the behaviour of alloys not in thermal equilibrium. This does not refer to the establishment of the "technical" diagram in the true sense of the word, which would comprise the study of the reactions that ensue with normal rates of cooling, such as take place after casting alloys on a technical scale and which generally do not differ in a theoretically interesting way from those that take place under equilibrium conditions; but it refers to the study of those extreme cases of reactions in solid alloys the state of which is far removed from equilibrium—*e.g.*, quenched alloys, and especially those which undergo ageing. Here the theoretical principles are still very obscure.

Let us now turn to a consideration of physical metallography. From a theoretical point of view the greatest interest in this branch is centred in the relation between plastic deformation and heat-treatment on the one hand, and the properties, especially the mechanical properties, on the other. This is also the principal practical problem where material with definite properties has to be obtained by suitable heat and mechanical treatment. The values of the desired properties are fixed by the needs of the moment—that is to say, the problem to be solved is the determination of the behaviour of the metal under the conditions of practice. This kind of material testing, in which the conditions of the test are made to resemble as nearly as possible those under which the metal will be used in actual practice and in which the correlation of the results of the test with definite physical magnitudes is avoided, we may call *technological* testing, in contrast with *physical* testing, in which well-defined physical properties of a metal are measured. For example, when we study the behaviour of a metal during corrosion we usually try to employ conditions which correspond with those occurring in practice; thus in investigating the corrosion of condenser tubes we work preferably with the actual condenser tubes and with water velocities such as occur in actual use. The resulte of such tests are complicated functions, not only of the different properties of the metal, but also of the conditions of the test. It is obvious that such a test has a purely empirical value, and no rational conclusions can be drawn from it as to the behaviour of the material under other conditions, or as to the effect of varying the metallurgical treatment. To obtain a deeper insight into the behaviour of the metal the physical and chemical properties must be investigated. With a knowledge of these properties, which are constants of the material, the behaviour of the metal under other conditions and after different metallurgical, thermal, and mechanical treatment may be established.

The development of rational metallography, therefore, progresses from the purely technological to the precise scientific side, and only in this manner can we expect any important advances to be made in our knowledge.

Tensile tests are intermediate between these two aspects of the subject. The standard test-piece and the simplified method of applying the load, which deviate greatly from practical conditions in order to obtain results of more general validity, have a certain scientific value. On the other hand, the properties determined by the tensile test

—namely, the elongation, reduction of area, and breaking strength—have a poorly defined physical meaning, and on this account the test possesses to a certain degree a technological character. A perusal of recent discussions on the plastic deformation of, and cohesion in metals will show how extraordinarily difficult is the treatment of this subject.

In the field of physical metallurgy we must therefore attempt to work only with well-defined magnitudes, the measurement of which has an exact physical character. The technique of physical measurements has several peculiarities. The physicist selects his apparatus and experimental conditions with extreme care, in order to measure the property under investigation as exactly as possible and with the smallest amount of interference, and he subjects his results to an exact mathematical treatment and criticism, calculating when necessary the limits of accuracy of his work, so that his experimental results have a greater degree of etrtainty than would be obtained without this purely mathematical and logical criticism.

An especially beautiful example of the results which may be expected from experiments carried out under well-defined physical conditions is the work of Taylor and Elam on the plastic stretching of single crystals; these investigators succeeded in expressing quantitatively the internal mechanism of stretching and slip by measuring all the changes that occurred in the shape of th test-piece during stretching and applying exact geometrical laws to the results. Another fine example of this type of work is the investigation of recrystallisation phenomena by Glocker and his collaborators. It is well known that all rolled metals possess a fibrous structure—that is to say, that the crystallites are definitely oriented as a result of the mechanism of slip.

To sum up, for physical metallography it is necessary to work on a systematic, methodical, and strictly exact physical basis, and not in the usual technological manner. This requirement is often very difficult to fulfil, especially when a technical problem is to be investigated; it must, however, always be borne in mind and every effort should be made to follow it since only in this way can we hope to make further advances in the science.

RESOLUTION PASSED BY THE COUNCIL OF THE BRITISH SCIENCE GUILD.

At a meeting held on Thursday, 17 October, 1929, the Council of Management of the British Science Guild passed the following resolution in relation to the constitution of the Royal Commission on the Civil Service :—

"That having in view the circumstances that the State directly conducts, under its own management, important and highly scientific and technical undertakings, such as the telegraph and telephone services, and also recognising that science has to-day a very important bearing upon so many of the problems dealt with in and by Government Departments, the Council is greatly disappointed to find that the Royal Commission on the Civil Service recently set up by His Majesty's Government does not include among the members a single man of science or one engaged in the application of science to the needs of the community. The Council records its emphatic protest at the omission to appoint upon the Royal Commission a due proportion of members familiar with national aspects of pure and applied science, particularly in view of the fact that an urgent necessity exists at the present time for a complete and impartial review of the status and functions of the considerable body of scientific and technical experts forming part of the Civil Service."

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Constituents of Corylopsis spicata, *SIEB. et ZUCC. Corylopsin. I.* By Shizuo Hattori.

Constituents of the Dementholised Japanese Peppermint Oil. By Shozo Tanaka.

Sinomenine and Disinomenine. IX. Two New Alkaloids, Acutumine and Sinactine, from Sinomenium acutum, *MAKINO (Menispermaceae).* By Kukuji Goto and Hideo Suzuki.

Catalytic Transformation of l-*Menthol.* Teikichi Hiraizumi.

Constituents of Coriaria japonica, *GRAY. I. Coriaric Acid.* By Kono Kinoshita.

INSTITUTE OF FUEL.

On 24th October the annual dinner was held at the Connaught Rooms, London, Sir David Milne-Watson, the President, presiding. Among those present were :—

Mr. J. H. Thomas, Lady Melchett, Lady Milne Watson, Sir Harry Haward (Elec-

tricity Commissioner), Sir Arthur Duckman, Dr. Daniel Adamson (president of the Institution of Mechanical Engineers), Sir Stephenson Kent, Sir Philip Dawson, M.P., Mrs. A. E. Dunstan, Sir Arnold Wilson, Sir Westcott Abel, Dr. and Mrs. F. E. Smith, Dr. William Cullen, Mr. and Mrs. R. W. Foot, Mr. and Mrs. T. Hardie, Mr. C. S. Shapley, Mr. John Terrace, Mr. W. Trimnell, Professor W. M. Travers, Engineer Admiral W. M. Whayman, Mr. J. K. Brydges, Mr. W. M. Selvey, Mr. F. W. Goodenough, Mr. J. A. Reavell, Mr. T. Westthorp, Mr. Frank Hodges, Mr. Evan Williams, Sir William J. and Lady Larke, Mr. Percy Ashley, Mr. and Mrs. H. T. Tizard, and Mr. F. Pierson.

Mr. J. H. Thomas, Lord Privy Seal, was the chief guest. Proposing the toast of " The Institute," Mr. Thomas asked why it had taken so long to bring into being a body so essential to the country. All engaged in the fuel industry realised that there must be a pooling of brains and ideas, and that they must adapt themselves to modern conditions and circumstances. Today they found themselves face to face with the high standard of living that experience and time had developed, and, on the other hand, they found that every year £800,000,000 had to be provided to purchase from people outside this country things that were essential to the life of the nation. Those things had to be paid for in gold or in kind. Speaking as a Labour leader and as a responsible member of the Government with a full sense of responsibility he wished to say that it in the great struggle that was now going on it was no good running away from facts. The nation could only continue to prosper, or even hold its own, if it concentrated on being able not only to pay for everything it bought, but have a little surplus as well. That was why the export trade of the country was vital, and why the fuel industry must realise that in the great struggle of the future of the future brains had to be mobilised. The fuel industry was the key to all industries, and the institute demonstrated that whatever might have been the slipshod methods of the past, brains and concentration on organisation must be the dominant notes of the future.

The chairman, replying to the toast, said it was absolutely necessary, if this country was to prosper, that the fuel industry should once more come to the top.

Lord Melchett, Founder-President, proposing the toast of " The Visitors," referred to the experiments being made in this country of extracting oil from coal, and said that when, in the not far distant future, they had achieved their object, they would open up a new era for the coal trade of the country.

NOTICES OF BOOKS.

Photoprocesses in Gaseous and Liquid Systems. By R. O. GRIFFITH AND A. McKEOWN. Pp. VIII + 691. London: Longmans Green & Co., Paternoster Row, E.C. 1929. Price 25s.

This volume is one of the series of *Textbooks of Physical Chemistry*, edited by the late Sir William Ramsay and Professor Donnan, and is intended for senior and research students. It not only incorporates the most recent advances in photo-chemistry and cognate subjects. As a preliminary to the purely photochemical matter much of the earlier part of the book is devoted to modern physical theory with special reference to such topics as atomic and molecular spectra, photoluminescence and chemiluminescence and the general foundations upon which present-day knowledge of the subject is based.

The later parts of the volume are concerned with photochemical changes, their energetics, kinetics and reaction mechanisms. The post-war developments in this branch of physical chemistry have received very full attention but earlier work is also referred to.

The slow development of photochemistry compared with other branches of physical chemistry is partly due to the need for a rather special technique, not easily acquired and again it lacked a theoretical stimulus. The introduction of the Quantum Theory by Max Planck and its applications to photochemistry by Einstein and others, together with a wider knowledge of the physico-chemical phenomena have led to an increasing interest in this important branch of physical chemistry. The present volume is therefore making an opportune appearance and should find an ever-widening circle of readers among physicists and physical chemists.

Tin. By C. L. MANTELL, Ph.D. Pp. 366. New York: Chemical Catalog Co. 1929. Price 7 dollars.

Dr. Mantell's volume on Tin is one of the American Chemical Society's series of comprehensive *Monographs.* It deals more particularly with the mining, production, technology and applications of this important metal, which although common enough in everyday life is indeed less abundant than such " rare " elements as titanium and

vanadium.

In addition, the history, physical and chemical properties of the metal and its compounds, are also described, together with its metallurgy, alloys, various industrial uses and its recovery from waste material.

The author's brief historical sketch is good and the sections on mining, metallurgy and uses are also very full and valuable, but the same can hardly be said of the purely chemical parts of the book. There are copious references to original literature, especially to the engineering periodicals, but the chemical journals have not been utilised so thoroughly. Thus, although a glance at the *General Index* to the first 100 Volumes of *The Chemical News* shows over three columns of references to tin and its compounds and alloys, scarcely a reference is taken from this Journal. More recent work has also been overlooked, for although the author makes mention (p. 262) of the tin hydrides, nothing is said of Weeks' discovery of the solid dihydride a few years ago. Again the present reviewer has published numerous papers since 1917 on double tin salts and certain organic compounds containing this metal, but not one is quoted, although some of these salts are described. This section and the all too brief "Analytical Methods" constitute a weak part in what might have been a most valuable monograph. J. G. F. D.

Empire Free Trade. By LORD BEAVERBROOK. Pp. 16. London: "The Daily Express." 1929. Price 1d.

The new policy advocated by Lord Beaverbrook, one of the foremost of modern publicists, has for its object the development of the resources of the British Empire by means of an inter-Dominion free-trade system. He desires that all foodstuffs and raw materials should enter this country free of all duty and he points out that the colonies could readily supply all the home country's needs as regards wheat and other foodstuffs. Presumably less would be required from foreign countries.

Men of science (to their disadvantage) are seldom interested in political questions. The ways of the politicians are seldom their ways, and so they have in the past held aloof from party discussions. Of recent years scientists have begun to make an attempt to obtain greater recognition for their services and will doubtless use their political power in this direction. When it comes to foreign affairs men of science should be able to show a better understand- continuously come in contact with fellow workers in all parts of the world. This gives them an international outlook and they will be firm supporters of any practicable scheme for bringing both the Empire and other nations closer together. Protective tariffs are not to their liking—except for certain manufacturers who reap a small benefit by such means at the expense of the rest of the community.

Empire Free Trade could well be a preliminary to World Free Trade.

In pre-war Austria-Hungary there was a species of empire free trade within a highly protective State, but its effect was not to stimulate endeavour or industry. The knowledge that a sure market existed for goods produced within the State led to a marked apathy among industrialists there. Would its effect be the same in the British Empire?

The Canadian Department of Mines has just issued (price 20 cents) a volume entitled *Comparative Tests of Various Fuels when Burned in a Domestic Hot Water Boiler.* By E. S. MALLOCH AND C. E. BALTZER. (Pp. 92.)

American anthracite has been the most widely used fuel in the eastern provinces of Canada up to the present time. The fuels now tested and reported on are those mined in Canada and include 8 anthracites, 2 cokes, 2 smokeless semi-bituminous coals and air-dried peat. In addition a number of Alberta and Nova Scotia coals were also examined. Welsh briquettes were the only British product to be tested.

PUBLICATIONS RECEIVED.

Catalogue of Standardised Morse Chain Drives, Letchworth, Herts. Pp. 82.

INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH, TOKYO.

"The Constituents of Matteucia Orientalis." By S. Fujise. No. 196. Price 20 sen.

"Ramen Effect on Organic Substances." By Y. Fujioka. No. 204. Price 55 sen.

"Slip-Bands of Compressed Aluminium Crystals. Part I. Distortion by Single Slipping and a Tentative Theory of Work Hardening of Metal." By K. Yamaquchi. No. 205. Price 45 sen.

"Stark Effect for the Spectral Lines of Chlorine, Bromine and Iodine." By K. Asagoe. Price 85 sen.

U. S. DEPT. OF AGRICULTURE.

Bulletin 141; The Spontaneous Combustion of Hay. By C. A. Browne. Price 10

CORRESPONDENCE.

BRITISH TAR FOR BRITISH ROADS.

(From Mr. W. Thorne, M.P.)

(To the Editor of THE CHEMICAL NEWS.)

Dear Sir,—My recent appeal to county councils and other public bodies to use British tar in the making and maintenance of our roads has provoked considerable controversy. The advocates of foreign bitumen, which is the alternative to tar, are very active in defence of their product.

It is stated, on behalf of bitumen importers, for example, that " the bitumen *industry means employment, whereas tar is* a by-product of the gas and coke industries and its use does not involve the direct employment of any more labour."

I would now ask those who take the same view how many British workmen are actually employed at the four bitumen refineries in this country. I suspect that they number at most a few thousand, but it will be interesting to have the figure for comparison with the 100,000 workers in the gas industry and the large number employed in the coke industry.

As for the second point, that a by-product does not in itself provide employment, I can only say that if, owing to the use of foreign bitumen on our roads, the market for British tar is lost, it will be a very serious matter for the gas, coke and steel industries, and also for the miners of this country, who find in the tar producers the biggest commercial consumers of coal.

If the price of tar be taken as 5d. a gallon, the gas companies alone receive £4,000,000 a year from this source. The loss of any considerable part of this vast sum would upset the whole industry, raise the price of gas, reduce its consumption, cut down the demand for coal, and lead to very serious unemployment. The same holds true if the coke industry loses its tar market because of the use of bitumen on our roads.

Let there be no doubt about the point that the use of British tar on British roads is vital to some of our biggest home industries —gas, coke, steel and coal. It seems folly, therefore, to add to their present troubles by going out of our way to use foreign bitumen as a substitute.

Yours faithfully,

W. THORNE.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.

Friday, November 8, at 4.30 p.m.—Indian Section. " The Indian Cinema Industry." By A. M. Green, I.C.S. Acting Trade Commissioner for India. Dr. T. Drummond Shiels, M.C., M.P., Parliamentary Under-Secretary of State for India, will preside.

Wednesday, November 13, at 8 p.m.—J. O. Boving: " New Developments in Pneumatic Engineering."

THE INSTITUTE OF PHYSICS.

Wednesday, November 27, at 5.30 p.m.—" Physics in Relation to the Utilisation of Fuel." By Dr. C. H. Lander, C.B.E., Director of Fuel Research, Department of Scientific and Industrial Research. The lecture will be given in the Rooms of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2. The chair will be taken by Dr. W. H. Eccles, F.R.S., President of the Institute of Physics.

UNIVERSITY COLLEGE, LONDON.

Monday, November 11, at 2 p.m.—" Tudor Commerce and Industry." A Public Lecture by Mr. N. F. Hall.

Tuesday, November 12, at 6.30 p.m. —" Engineering Management." First of a course of three public lectures by Mr. E. T. Elbourne, M.B.E., A.M.I.Mech.E. November 12, 19 and 26.

SOCIETY OF DYERS & COLOURISTS.

Manchester Section.

November 15, at Milton Hall, Deansgate. —" Peter Griess." By Dr. F. A. Maison, M.A.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

31,179.—Adco, Ltd., and Ashen, J.—Apparatus for manufacture of nitrogenous fertilisers. October 14th.

31,238.—Bowden, W. H.—Method of producing liquid preparations from sulphur, etc. October 15.

31,125.—Bunbury, H. M., and Clarke, R. B. F. F., and Imperial Chemical Industries, Ltd.—Manufacture of sulphurised fatty oil products, etc. October 14.

31,728.—Halowax Corporation. — Purification of chlornaphthalenes. Oct. 18.

31,158.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of arylides of aromatic hydroxy carboxylic acids. October 14.

Specifications Published.

280,841.—Oranienburger Chemische Fabrik Akt.-Ges—Process for the production of halogen-substituted organic sulpho-acids and their salts.

320,318.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges). — Production of styrene and homologues thereof.

320,409.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Process for the manufacture of yellow ferric hydroxide.

320,424.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Process for the manufacture of primary alcohols.

Abstract Published.

317,966.—Alkali peroxides. — Imperial Chemical Industries, Ltd., Millbank, London, Holt, F., 146, Greenway Road, and Mitchell, J. A. M. W., 29, Victoria Road, both in Runcorn, Cheshire.

Alkali peroxides, for example sodium peroxide or a mixture of sodium and potassium peroxides, in powder form, are prepared for use in respirators by heat treatment in the presence of a flux such as about 1 per cent. of caustic soda or potash for about $1\frac{1}{2}$ hours until the mass is agglomerated without fusion, and by subsequent grinding or crushing of the agglomerated porous mass. The crushed product comprises a granular portion, and a fine powder which is separated and re-treated. The treatment may be facilitated by the addition of a catalyst such as manganese sulphate which may impart a characteristic colour to the final product. The flux may be formed in the material itself by absorption of atmospheric moisture, for example during an initial grinding process.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

AVIROLIT.

506,445.—Chemical substances in class 1, for use in the dyeing industry.—H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Saxony, October 28.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

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TECHNICAL TRANSLATIONS.

Translations from and into French or German undertaken by a competent linguist. Charges moderate. Enquiries invited.—J. L. c/o *Chemical News.*

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

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DICTIONARY OF EDUCATIONISTS.

By REV. J. E. ROSCOE, M.A.
Pp. 400. Price 5/-. By Post, 5/4.
CHEMICAL NEWS, LTD.,
MERTON HOUSE, SALISBURY SQUARE,
LONDON, E.C.4.

This is an interesting and useful Work, giving in tabloid form Biographical Sketches of Prominent Educationists from the earliest times and in all countries. Mr. Roscoe has written many important books, but none of greater importance in its own sphere than the above Work.

ARC ELECTROLYSIS.

By ROBERT SAXON, B.Sc., F.C.S.,
Mem. Amer. Chem. Soc.

The electric arc affords a ready means of isolating metals by electrolysis from molten salts. It needs no special vessel with parts to crack and crumble under repeated expansion and contraction, no electrodes to wear away and add their filth to the electrolyte, and no troublesome leaks to keep in repair. For simple trials nothing more is required than the two carbons used in an arc, the fatter the better. In five to ten minutes sufficient metal may be produced to indicate its presence in elementary form.

The lower of two vertical carbons is made the cathode. Vertically down into the lower carbon a hole is drilled with an ordinary twist drill, as broad as the carbon will allow. The author has produced most satisfactory results with a half-inch carbon, drilled with a 3/16in. hole, but of course a bigger size would give better results. It is all a matter of available voltage. That used is from the service plug as 220 volts. A higher voltage would allow a wider carbon. When the current is switched on to jump the gap between top and bottom carbon it has less chance of shorting to the carbon itself instead of passing through the salt with a thicker carbon than with a thinner one. To make the gap jumping from carbon to carbon the top of the hole is countersunk by a rose-bit, that is its top brim is widened out at an angle of 45 degrees, just as it would be if intended to receive a screw head, that is an ordinary wood-screw.

Into the hole is dropped a drop of mercury to amalgamate with the alkali metals, which proceed downwards to the cathode bottom of the hole. Powdered salt to be split up is dropped into the hole and pushed well home to fill the hole and make a convex top at the wider brim. If the current be now switched on and the top carbon be brought with its nose in contact with the salt, melting will begin. Rig up a screen of yellow and green glass, and watch the melting, along with the behaviour of the "caterpillar" glow between the carbons. Note the spray from the top carbon, and the way in which the caterpillar rears its back like a frighted cat away from the centre between its stellar ends anchored to the carbon tips. We have a good introduction to the study of the discharge in the exhausted tube, for but for the attraction of the cathode the glow would be scattered.

Note that the sparks at each end of the caterpillar are not due to stunning of the retina, and production of local irritation, but are actually dispersion as may be seen through the thickest screen.

SUBLIMATION.

The top carbon becomes rapidly coated with a deposit of salt. This on examination proves to be the original by analysis. Such a chance of melting and subliming salts is not at all possible without most expensive and elaborate apparatus. From the boiling points of salts, as contained in many publications like the Year Book, and a most valuable such work as the Handbook of Chemistry and Physics, published by the Chemical Rubber Publishing Co., Cleveland, Ohio, at $2.50, we may arrive at the approximate temperature the arc employed can raise reagents to. Too long an experiment will result in the mercury boiling away, beyond recovery. A metal core may be used in these trials, but it must not come out at the top. Such tends to keep the current in the centre. This current will show a most decided preference for the sides.

THE SPECTRUM.

We have here a most successful means of showing the spectrum of every metal dealt with, as salt or core. In the latter case prepare a carbon by drilling through it, from the bottom of the hole deep enough to take the wire of the metal to be experimented on. Half an inch is ample depth, and of course the top may be above the carbon top. Arrange the arc so that the slit is well lit from the arc when seen without the prism, or grating. The prism gives best results. Take sodium chloride as standard, and find position for prism for minimum deviation. Take the angle and make this standard. Mix potassium and sodium chlorides and using the D line as standard, mark out the position of the potassium lines. Proceeding further with all the other salts available, always mixing with sodium chloride to keep our standard, the spectra of a number of metals may be studied. There is no method known to the author which gives so clean and decided a spectrum as this. The light is so powerful that the spectrum shows up with full daylight playing on the prism, and the cross wires can be easily seen on that account, which is by no means the case in the sparking coil method, or that exasperating bent tube with platinum brush. It is not too much to say that with an enlarging arrangement as the constant deviation prism, or the ring of prisms this is the only satisfactory method, for in the ordinary cases the exposure of the plate has to be a long one.

THE STRUCTURE OF ALPHA-METHYLXYLOSIDE.

By F. P. PHELPS AND C. B. PURVES.
(*U.S. Bureau of Standards.*)

Crystalline trimethyl xylose, derived from the corresponding β-methylglycoside, was the first member of the methylated monosaccharides to which an amylene-oxide ring structure could be assigned with certainty, and at the time the opinion was expressed that not only α- and β-methylxyloside, but possibly xylose itself, were similarly constituted. The intervening years, however, have brought to light several cases in which methylating agents, applied to a reducing sugar, have produced derivatives of more than one ring type, and in this connection the behaviour of galactose and arabinose may be cited. Pryde Hirst, and Humphries have shown that in the case of these two sugars methylation with methyl sulphate and alkali undoubtedly gives at least two ring forms. In the case of xylose, also, this method gives an impure product, the rotation of the methylated products being too low in addition to the yield being small. Our own values obtained through the use of this method are in approximate agreement with those of Carruthers and Hirst, using the same method, and are much lower than the values obtained when pure α- or β-methylxyloside was methylated with silver oxide and methyl iodide. Likewise it is now well known that the condensation of a reducing sugar with acid methyl alcohol, if carried out at room temperature, yields a γ-methyl glucoside, while at higher temperatures, such as Fischer originally used, a mixture containing largely the α and β forms is obtained. Our own work indicates that all three are formed at an intermediate temperature and that the equilibrium reached in acidified methyl alcohol is not an equilibrium between the α and β forms only, but between the α, β, γ, and perhaps, other forms as well, the predominating form being determined by the conditions, of which temperature is particularly important. As only two of these three forms can have the same ring structure, the third must have a different ring, and there is no known way to tell which, if either, of these rings

exists in the parent sugar. It accordingly follows that any conclusions regarding the identity of ring structure in the sugar series to be satisfactory must be based upon nothing less than a direct experimental identification and correlation of the derivatives concerned. Such a correlation has now been made for α- and for β-methylxyloside.

The earlier methylations of this sugar were carried out by Carruthers and Hirst, who used methyl sulphate and caustic soda to prepare the β form and Fischer's method, to condense xylose with methyl alcohol for the α form. In the latter case, after that portion of the β-methylxyloside which crystallised from the product had been removed, the residual crude syrup was treated with silver oxide and methyl iodide and gave a mobile liquid with the elementary composition of a fully methylated pentose. When heated in acid methyl alcohol, this liquid displayed a final specific rotation of 50.4°, a value in good agreement with that of 49.5° acquired by *trimethyl β-methylxyloside* under similar circumstances. Such behaviour has long been considered to be characteristic of an α-β pair of methyl glycosides possessing the same ring structure, and the reasonable inference was made that one more example of the same phenomenon had been encountered. While, therefore, it is true that trimethyl α- and β-methylxyloside have been correlated, the method used was an indirect one, and a series of considerations led the present authors to doubt its reliability in this case. Thus, the methylated glycosides examined by the former workers did not conform to the decisive test of similar ring structure devised by Purdie and Irvine in that trimethyl β-methylxyloside, when hydrolysed with aqueous acid, yielded a crystalline trimethyl xylose, $[\alpha]_D = 20°$ in water, while the impure α isomer gave rise to a lævorotatory syrup. Moreover, the correlation adopted by Carruthers and Hirst is not valid if two trimethyl rotations in acid methyl alcohol; a possibility which can not be counted remote when it is remembered that Haworth and Westgarth have recently prepared a second trimethyl xylose with a specific ratation of 81.2° in water, or within 12° of the former figure. Thirdly, in the preparation of trimethyl β-methyl xyloside from xylose by the methyl sulphate and sodium hydroxide method there is some uncertainty because of the small yield obtained, together with the suspicion that this method does not always yield a single product. If the trimethyl β-methylxyloside contained a large unknown percentage of a second compound of similar properties and, therefore, difficult to separate and, as in this case, on hydrolysis yielded less than 50 per cent. of the theoretical amount of trimethyl xylose, it would be difficult to say which of the two components in the parent mixture produced the trimethyl xylose. A fourth consideration lay in the fact that α methyl glucoside, methyl-galactoside, and methyl-arabinoside are directly correlated, in each case, to methylated derivatves which very probably possess an amylene oxide ring. It follows that a similar structure must be assigned to the glycosides themselves, and if this is so, a computation in molecular rotations by the method of Hudson leads to the conclusion that the 1 : 5 oxygen linking is not present in α-methlyxyloside. As this is at variance with the accepted structure for the β-isomer, Dr. C. S. Hudson requested us to repeat the work of Carruthers and Hirst and to obtain more decisive experimental evidence on the matter.

The *carefully purified crystalline* α-methylxyloside was methylated by the silver oxide reaction, and every care was taken to render the methylation complete. Although the trimethyl α-methylxyloside could not be made to crystallise and purification was carrried out by the uncertain method of distillation, the specific rotations determined, 121.7° in chloroform, 112.7° in water, and 122° in methyl alcohol, are regarded as approximately correct. When methylated in similar fashion β-methylxyloside gave an excellent yield of the crystalline, fully methylated derivative. Purification was rigorous, and the final constants were m.p., 51°; $[\alpha]_D^{20} = -69.5°$ in chloroform, and −81.7° in water. Aqueous acid, of a lower concentration and at a lower temperature than that previously employed, hydrolysed both trimethyl methylxylosides, 80 to 85 per cent. of the theoretical yield of crystalline trimethyl xylose being isolated in each case. The two specimens of the sugar were then compared with each other and found to be identical. Mutarotation in water was swift, the initial specific rotation being 65° and the equilibrium rotation 17.7° in place of the value of 20° hitherto accepted as standard. Trimethyl xylose occasionally displayed mutarotation in chloroform solution, the initial value of $[\alpha]_D^{20} = 58°$ diminishing to 24°; also the *initial rotation in this solvent was quite* erratic, lying anywhere between 58 to 45 after recrystallisation from ether solution. In these cases it is possible that the sugar crystallised as a mixture of the α and β

forms. The value of 58° is, therefore, to be taken with caution. One other point remained to be considered, for trimethyl β-methylxyloside prepared by the methylation of xylose in alkaline solution had a specific rotation some 10° lower than the correct value of -69.5° in chloroform. The similar observation of Carruthers and Hirst was thus confirmed, and recrystallisation failing to improve the constant, the possibility remained that the two methods of alkylation had produced isomeric substances. On hydrolysis, however, the specimen with the incorrect specific rotation also gave trimethyl xylose in 75 per cent. of the theoretical amount, and the discrepancy was seen to be due to an impurity, possibly an isomeric form, which was difficult to remove. This observation should be of value when it is desired to prepare a methylated sugar in a state of optical purity by the aid of methyl sulphate and of alkali.

EXPERIMENTAL*.

Preparation and Properties of Trimethyl β-Methylxyloside.

(*a*) A 5 g portion of pure crystalline β-methylxyloside, $[\alpha]^{20}_{D} = -65°$ in water, was methylated in the standard fashion with 40 g of silver oxide and 25 ml of methyl iodide, a little methyl alcohol being present in this first methylation only to dissolve the glycoside. Acetone was used to recover the product, which was then submitted to a second and third treatment with the same reagents. The final separation of the trimethyl β-methylxyloside from the inorganic residues was effected by extraction with ether, the yield of the crude, crystalline material after evaporation of the ether being 5.52 g, or 88 per cent. of theory. After three recrystallisations from petroleum ether, cooled in ice and salt, the specific rotation in purified chloroform was -69.6°. This value was not appreciably changed by two further recrystallisations. Estimation of methoxyl by Zeisel's method : 0.3144 g gave 1,3968 g of silver iodide, corresponding to 58.7 per cent. OCH_3. Theory gives 60.2 per cent. A subsequent larger scale preparation (23 g), after purification by several recrystallisations from ordinary absolute ether cooled in ice, yielded substantially the same figures for the specific rotation, namely, -69.4 in $CHCl_3$ and -81.8 in H_2O.

(*b*) A 25 g sample of carefully purified xylose was methylated as described by Carruthers and Hirst, first with methyl sulphate and alkali and then with 33 g of silver oxide and 17 ml of methyl iodide. The product crystallised on recovery from the latter process. Yield, 20 g or 64 per cent. of the theoretical. Once recrystallised it had an observed rotation of -0.34° and a specific rotation of -59.6°. A second recrystallisation failed to change this value.

Preparation and Properties of Trimethyl α-Methylxyloside from Pure α-Methylxyloside.

Pure α-methylxyloside, prepared by the method of Bourquelot, $[\alpha]^{20}_{D}+154.0°$ in water was methylated with 60 g of silver oxide and 37.5 ml of methyl iodide for a 7.5 g sample. Methyl alcohol, 2.5 ml) was also present, in this first methylation, to enable the xyloside to dissolve. Three such operations, however, failed to complete the methylation, as was evident when the liquid product was distilled, the refractive index varying with the fraction on which it was observed. Methoxyl, found, 58.4 per cent.; theory, 60.2 per cent. Accordingly, the total distillate of 7 g was remethylated with 8 g of silver oxide and 5 ml of methyl iodide. After recovery it was dissolved in water and extracted with chloroform in order to remove most of the lower methylated impurities, and the syrup, obtained from the anhydrous chloroform extract, was methylated for a fifth time. Evaporation at 80°/20 mm, freed the trimethyl methylxyloside from solvent, last traces of which were eliminated during the distillation; bath 110°/10 mm. Rejecting the first six drops of the distillate, the seventh was found to have n^{24}_{D} 1.4891 and the last n^{25}_{D} 1.4887. Since data drawn from the work of Carruthers and Hirst show that the change in refractive index per degree rise in temperature is -0.00036 for a methylated xylose, the indices quoted are regarded as equivalent. In an estimation of methoxy groups by Zeisel's method, 0.1151 g gave 0.5208 g of silver iodide. Found OMe 59.7 where theory requires OMe 60.2 per cent.

* All methylations with silver oxide and methyl iodide were carried out in a round-bottomed flask equipped with an efficient water-cooled condenser, the two being united by a ground-glass joint in place of the customary rubber stopper. This innovation, while giving a product free from contamination by rubber, and, therefore, more readily purified, required care in its use, as flask and condenser readily became cemented together.

In purified chloroform the observed rotation was +121.2°, and in water +112.2°, values not appreciably changed by redistillation. Trimethyl α-methylxyloside, therefore, has a specific rotation in chloroform of the order +121.5°. Similar measurements were made in water and in methyl alcohol.

$[\alpha]_D^{20}$ in water = +112.7°

$[\alpha]_D^{19}$ in CH_3OH = +122.2.

Preparation and Properties of Trimethyl α-Xylose.

(a) Pure trimethyl β-methylxyloside, 6.29 g, dissolved in 120 ml of 4 per cent. hydrochloric acid, was maintained at a temperature of 85° C. The initial specific rotation of −78.1° increased, during 75 minutes, to a nearly constant value of +14.8° whereupon the solution was neutralised with barium carbonate and filtered. In this preparation trimethyl xylose was isolated by a tedious extraction of the filtrate with large volumes of chloroform and by evaporation of the anhydrous extract to a syrup. A partial crystallisation quickly occurred, and the crystals were recrystallised from ice-cold ethyl acetate. Yield, 2.8 g; m.p., 91°-92°; $[\alpha]_D^{20}$+54.3° in chloroform. The original mother liquors, on standing at 0° for two days, deposited a further 1.2 g; while further quantities were obtained from the residual syrup on longer standing. Eventually the yield of crystalline trimethyl xylose reached 85 per cent. of the theoretical. After two recrystallisations from ether, the chloroform solution had a rotation +56.4°.

NEW CONSULAR APPOINTMENT AT MARACAIBO.

The Department of Overseas Trade announces that Mr. T. J. Anderson, who has been appointed to be His Majesty's Consul at Maracaibo, Venezuela, will be available at the offices of the Department during the period 11 to 30 November inclusive, to interview, by appointment, manufacturers and merchants interested in the export of British goods to Maracaibo or to the Dutch colonies of Curaçao and Aruba, which will be included in Mr. Anderson's consular district.

Firms desiring interviews with Mr. Anderson should apply at once to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting reference No. 1924/29.

SOME OBSERVATIONS ON SCHOOL CERTIFICATE CHEMISTRY.

During the last forty years much attention has been given to the *methods* of teaching Introductory Science, including Chemistry. School Certificates have come into being and a course of Elementary Chemistry has crystallised, with surprisingly small differences between the requirements of about a dozen different Examining Bodies.

During this period, and especially since the Great War, Chemistry in the outside world has been advancing very rapidly. The greatest developments have been in the direction of simplification, in the substitution of synthesis from elements and direct composition for the long and cumbrous methods of former times. Without striving after paradox, it can truly be said that applied Chemistry is rapidly becoming Elementary Chemistry or Chemistry of the Elements. It is necessary, therefore, for schoolmasters to consider whether a great deal of what they are teaching is really Chemistry in a general sense, or whether it is Chemistry eked out by convenient but uneconomical laboratory methods.

Formerly, we rather looked askance at the introduction of industrial methods into the school course; they were frequently complicated empirical methods and the description of them could not be neatly rounded off with a chemical equation. Now, however, many industrial processes are simple in principle and can be illustrated by reasonably intelligible imitation experiments. There seems to be no reason why some of these methods should not be adopted as standard methods of preparation; the steaming of red hot iron, for example, seems preferable to the action of zinc on sulphuric acid as a preparation of hydrogen.

There is no desire on the part of the writer of this article to quibble about the exact meaning or the examination significance of "prepare" and "obtain," whether they are to mean laboratory preparations or preparations on a large scale. What is contended is that if the question: How is hydrogen prepared? a distinction ought somehow to be made between a reaction such as the *steaming of iron*, which is an economically possible preparation of hydrogen, and the action of dilute sulphuric acid on zinc, which is a preparation of zinc sulphate in which hydrogen happens to be liberated. To put the matter in another way, we should never think of giving $CaO+2HCl=CaCl_2+H_2O$ as a preparation of water, though we do give $CaCO_3+2HCl=$

$CaCl_2+H_2O+CO_2$ as a preparation of carbon dioxide.

The following examples indicate some of the places in which it is submitted that improvements might be made in the teaching of elementary chemistry.

Air.—The teaching about air, especially when the historical method is used, is apt to end with Cavendish and the tale of the two legs of mutton, leaving the pupil with the notions that Cavendish was an odd fellow and that air is essentially a mixture of oxygen and nitrogen—one possibly right and the other certainly wrong.

Until quite recent times carbon dioxide was described as an " impurity " in air; water vapour was left out of account because, owing to its variability in amount, it had to be excluded from exact analyses; and as for solid matter, that was, and still is, frankly regarded as dirt. Yet without these five constituents we cannot explain all we know about air and life, or air and the conditions under which we exist. There is indeed a vast difference between natural air and chemist's air which has been "purified" by being passed through potash and dried with sulphuric acid.

Oxygen and Nitrogen are now obtained from liquid air. The decomposition of mercuric oxide is connected with a very important piece of chemical history, and the action of heat on a mixture of potassium chlorate and manganese dioxide is a good example of catalytic action, but they are scarcely to be regarded as oxygen " preparations," except in a limited sense. The process of MM. Brin Frères has not entirely disappeared from the oxygen chapter. It is excellent as an example of reversible reactions.

Water.—The large scale treatment of water has been rather neglected in elementary text-books. It is a great industry in which important developments are taking place, particularly in the simplification of low pressure filtration, the introduction of high pressure filtration and sterilization by chemical treatment.

Carbon and Its Oxides.—The charcoal burner's very wasteful operations have not entirely disappeared from elementary text-books. Carbon monoxide is not prepared from either a formate or from oxalic acid, except in chemical laboratories, while carbon dioxide, when required in very large quantities, is obtained by the thermal decomposition of calcium carbonate.

Ammonia.—The synthesis of ammonia from nitrogen and purified water gas is simple enough and should find its proper place beside the decomposition of ammonium salts by slaked lime.

Nitric Oxide and Nitrogen Peroxide are only intermediates; they are made by synthetic methods and there seems to be very little reason now for the introduction of the complicated nitric acid reactions (*e.g.*, $3Cu+8HNO_3$, etc.) at an elementary stage.

Sulphur and Sulphur Dioxide.—The sulphur kiln with a sloping floor, built on the side of a hill, etc., is still familiar in school Chemistry. The Frasch process should certainly be dealt with in an elementary course. The action of concentrated sulphuric acid on copper, though greatly beloved by examiners, might well be moved from the elementary to the Final Honours course and its place taken in the school course by the simple synthesis and the burning of iron pyrites.

All teachers are, nevertheless, bound by some examination or other, and the candidates's prospects in life cannot be ruined for the sake of pedagogic propriety. The Examining Body, however, prescribes only a syllabus; it does not say how the subject is to be treated within the limits of that syllabus.

It is some comfort to know that the art of examination has improved within recent years. In days gone by, not only was the question drawn from a pigeon hole by a really methodical examiner, but the answer was too, and the old-fashioned hack examiner was apt to look with disfavour at anything that did not agree with the traditional answer expected. There is now more latitude. The modern examiner can scarcely insist on the preparation of carbon monoxide from oxalic acid unless he is careful to specify this method in order to prevent the candidate from reducing carbon dioxide with hot carbon.

Some effort to lighten the ship at the School Certificate stage would be most welcome. Given a free hand, a body like the Science Masters' Association could probably do a great deal without altering existing syllabuses. It is evident that some complicated reactions could with advantage be cut out. A careful examination of the existing course would reveal some points of purely academic interest that could well be left to a later stage. Monoclinic sulphur is not very interesting to a fifth form boy; the meticulous drying of gases is often a delusion; the difference between physical and

chemical change is inconclusive and the multiplying of reasons for calling air a mixture is really a waste of time.

Elementary Chemistry stands in great need of simplification, but this cannot be done until Examining Bodies will agree to keep off certain topics. With goodwill, on the other hand, and co-operation between examiners and teachers, it should be possible to produce a course of Elementary Chemistry equally suitable for those going on to Higher Certificate and for those who will leave school after obtaining the School Certificate.

An attempt has been made in Mr. G. H. J. Adlam's *A School Certificate Chemistry** to introduce some of the modifications mentioned in the foregoing notes without endangering the chances of the pupil's success in examinations as they are at present constituted. Traditional methods of preparation, as well as others, have been mentioned, and "examination" matter of somewhat doubtful value has been included. Changes in teaching practice work themselves out slowly, and reformation is always preferable to revolution, especially to those past middle age.

* *A School Certificate Chemistry.* By G. H. J. Adlam, M.A., B.Sc., Senior Science Master at the City of London School. Pp x + 334, 112 diagrams. 1929. Price 4s. 6d.

GENERAL NOTES.

IMPORTS FROM GREAT BRITAIN AND THE UNITED STATES TO CANADA.

If Canadian imports from the United States are compared with those from Great Britain it will be noted that Canada is now buying five times as much in the former market as in the latter, states the Royal Bank of Canada. Raw cotton for Canadian textile mills must, however, be bought from the United States, and the coal for the manufacturing industries of Ontario must come from the source where it can be provided at least cost. Automobile parts which are used in Canadian automobile plants, petroleum, and fresh fruit are not items which may be bought from Great Britain, and yet the value of this small number of products is almost equivalent to the value of the total Canadian imports from Great Britain. It will require careful analysis of the items in which there is possibility of competition between Great Britain and the United States if means a reto be found to increase British sales in Canada.

DYESTUFFS (IMPORT REGULATIONS) ACT, 1920.

Applications for Licences in October, 1929.

Board of Trade Announcement.

The total number of applications received during the month was 694, of which 628 were from merchants or importers. To these should be added 18 cases outstanding on the 30 September, making a total for the month of 712.

BRITISH INDUSTRIES FAIR IMPROVEMENTS.

A step towards improving the appearance of stands in the British Industries Fair was taken by the London exhibitors' advisory committee on November 4, when it was agreed that, except by special permission, all stands at Olympia made of stock material should have fascias three feet deep on pilasters eight feet high. It was stated that there was no intention of interfering with stands owned by exhibitors or those of a distinctive type or design, but that much could be done towards uniformity by avoiding the unnecessary irregularities of ordinary stands.

NON-SKID ROAD SURFACES AND BRITISH TAR.

Sir David Milne Watson's Appeal to The Government.

"Despite the enormous expenditure of £60,000,000 a year, the roads of the country are still inadequate to meet the growing demands made upon them," said Sir David Milne Watson, the President of the British Road Tar Association, addressing the second annual meeting held at the Hotel Metropole, London, on 5 November.

Of the 2,000,000 tons of tar produced annually in this country, of an approximate value of £4,000,000, only one-third, said Sir David, was used for the purposes of road construction and maintenance on the 180,000 miles of our highways.

"'It may perhaps be permissible to suggest what is required of a modern road. The motorist, I think, continued Sir David, desires a non-skid, resilient and dustless surface; the horse driver something with a certain grittiness on the surface; the ratepayer something substantial but at the same time economical and durable, and the surveyor a combination of all the foregoing. Road tar cvan, we are confident, provide the binding material to meet all these demands. Surely it is not too much to ask that a Government, pledged to the reduction of unemployment should bear in mind when executing its programme that it has in home-produced tar a material which is produced in sufficient quantities to meet all demands. We ask in fact that British tar should be used more and more on British roads.

FIRST RUSSIAN AUTOMATIC EXCHANGE OPENED.

Russia's first automatic exchange at Rostov on the river Don a notable step in the modernisation of the telephone system determined upon by the Soviet Government —has just been opened. The equipment was manufactured partly in Sweden and partly by the Soviet factory, Krasnaia Zaria, and the total cost of the installation was about £154,000. The exchange is stated to be giving satisfactory service.

MINERAL TRANSPORT.

The following commenct on the Report of the Standing Committee on Mineral Transport, of which Sir Arthur Duckham was Chairman, are issued by Mr. Philip Gee at the request of Mr. C. H. Taynton, Secretary of the Association of Private Owners of Railway Rolling Stock.

The Report of the Standing Committee on Mineral Transport admits that the Railway Companies are under no legal obligation to provide coal wagons (except in strictly limited special areas); and it is a fact that they have refused to do so. As a result private traders, by providing their own wagons, have relieved the Railway Companies of (a) the enormous capital cost of supplying wagons to the collieries; (b) the financial risk of supplying wagons to new colliery undertakings, which might be thrown back on their hands as surplus if the colliery failed.

Collieries cannot keep their pits regularly working or regulate their output to meet variations of demand without possessing an ample reserve of wagons for that purpose, and the coal so stored constitutes the nation' sreserve stock, and it must be emphasised that wagons for storage purposes are available only under a system of private ownership. The Railway Companies refuse to supply them for that purpose.

The great error into which the majority of the Committee has fallen is to recommend compulsory pooling, though inevitably those members of it who really possess practical knowledge of the coal trade through being actively engaged in it, dissociate themselves from that recommendation. Pooling or common use of wagons of a voluntary nature amongst collieries is practised already where various collieries are amalgamated under one control or ownership; it is on the increase, and it is proving a success because the wagons are under one control and natural lines of development are being followed. As many colliery-owned wagons are already operating in so-called pools of that nature, the process should have been encouraged to continue naturally. Even the Samuel Commission (on whose recommendations the Duckham Committee was formed) expressly rejected any scheme of compulsory pooling of privately owned wagons and suggested instead that the Railway Companies should offer inducements by way of rebate, or otherwise, to wagon owners to pool their wagons voluntarily.

As against a very small problematical saving in one direction, compulsory pooling must lead to considerable additional expense in another by necessitating the formation of entirely new organisations with large clerical staffs to control the pools and allot the wagons. Stoppages, extra cost and delays must inevitably be occasioned amongst contributors to the pool, none of whom would be able to rely upon being supplied with the number and type of construction of wagons essential to his particular trade, whilst the running of the wagons in traffic must deteriorate, because a pool organisation cannot follow them up as efficiently as individual owners do. The question of repairs to compulsorily pooled wagons also presents considerable difficulties and there would be a great deal more expense and delay than under the present ssytem.

On the subject of larger wagons the Committee recognises that sufficient facilities do not at present exist at loading and unloading points for the general use of large capacity wagons, and that under existing conditions, as the Report says, the 12-ton wagon is the most siutable for general use.

JAPAN'S TRADE AND INDUSTRY IN 1928-29.

The period under review (the twelve months ended 30 June last) may be loosely described as one of recovery retarded by restrictions upon credit, those restrictions, in their turn, being due to the lack of confidence and the disruption following the financial crisis, writes Mr. G. B. Sansom, C.M.G., British Commercial Counsellor at Tokio, in at joint Report on Economic and Financial Conditions in Japan.

Such a description is based upon the assumption that there is a normal condition of finance, industry and trade in Japan, which was effaced by the crisis and will eventually reappear. The economic development of Japan, however, at least since the beginning of the European war, has been marked by so many features described as abnormal — the stimulus of the war period, the post-war depression, the earthquake, the financial panic of 1927, and the continued disturbances in China—that it is perhaps better to regard the so-called normal condition as fictitious, or at least ideal. Certainly, if one looks at the major industries of Japan one finds that, despite financial upheavals and despite disastrous individual failures, there has been, in the aggregate, a steady and considerable increase in the volume and quality of production.

There is a tendency among persons commenting upon economic as well as political events in Japan to judge them by a high and rigid standard which they would not always readily apply to their own countries. Nobody can deny that in recent years the financial organisation of Japan has only with difficulty withstood the frequent strains to which it has been subjected but it by no means follows that industrial development in general has been unsound or inadequate. It is the opinion of the writers of the Report that, making ample allowance for all unsatisfactory features, industrial progress has been remarkable and well sustained.

WHOLESALE PRICES IN OCTOBER.

An average advance of 1.6 per cent. in food prices last month was practically offset by a decline in prices of industrial materials. The result is an index number of 81.9 as against one of 81.7 in September. The figure for October of last year was 83.1.

CANADA'S TRADE WITH GREAT BRITAIN.

There is cumulative evidence of renewed interest on the part of the British public in the economic situation in Canada. This is best exemplified by the steadily increasing number of inquiries from British sources concerning the outlook for Canadian securities and by the increasing number of British financiers and statesmen who have vitited the country during the past two years. It is only natural that British enterprise should seek a greater share in the benefits of the broad and stable prosperity of Canada. In view, then, of the general desire to foster trade between Canada and Great Britain, an analysis of the character and volume of the present trade may present facts which may prove of assistance toward this end.

A study of Canadian foreign trade shows that the expansion of the volume of both imports from and exports to Europe, the Orient, and the United States, has been more rapid than was that of the trade with Great Britain. In 1913 the value of exports to the Orient amounted to $2,653,000 and in the past twelve months they have amounted to $68,000,000. The exports to Europe in 1913 amounted to $16,466,000, and in 1929 the total exceeded $200,000,000. Exports to Great Britain in 1913 amounted to $170,000,000, and in 1929 to $429,000,000. The corresponding figures for exports to the United States are $139,725,000 and $500,000,000 respectively. It is true that a much larger proportion of Canadian exports to Europe are now sent direct and this has reduced the apparent value of both imports from and exports to Great Britain.

On the import side it may be noted that the total value of Canadian imports is now almost twice as large as in 1913. If we allow about 50 per cent. difference for change in price levels, this implies that the volume of imports is approximately onethird larger than before the war. Imports from Great Britain in 1913 amounted to $138,742,000 and in 1929 to $194,000,000. Making the same allowance for change in price levels that is made above, there has been a decline of about 10 per cent. in the volume of imports from Great Britain.

If Canadian imports from the United States are compared with those from Great Britain, it will be noted that Canada is now buying five times as much in the former market as in the latter. Such general statements have little meaning. Raw cotton for Canadian textile mills must be bought from

the United States, and the coal for the manufacturing industries of Ontario must come from the source where it can be provided at least cost. Automobile parts which are used in Canadian automobile plants, petroleum, and fresh fruit are not items which may be bought from Great Britain, and yet the value of this small number of products is almost equivalent to the value of the total Canadian imports from Great Britain. It will require careful analysis of the items in which there is possibility of competition between Great Britain and the United States if means are to be found to increase British sales in Canad .

Canada buys a preponderant amount of wool, including raw wool, noils and tops, yarn, carpets, fabrics, and wearing apparel in the British market. Tea, toys, oilcloth, tin, lace, leather, hats, and caps, flax, hemp ,and jute, cotton wearing apparel, fabrics, and sodium compounds are other items, a large proportion of which now come from Great Britain.

At Regent Street Polytechnic on November 4, Mr. J. V. Hyka, lecturing on the *Economic Relations between Czechoslovakia and Great Britain* urged manufacturers to study conditions on the spot. Little trade would result if the matter was left to agents who, as he had found, were often situated in Vienna or Germany and thus not specially interested in introducing British goods on to the Czechoslovak market. He reviewed the financial situation of that country, the only one in Central Europe to avoid inflation, and indicated the trade prospects there. He divided Czechoslovak industries into three groups, those with raw materials at home, those which imported part of their requirements, and those whose raw materials were wholly from abroad. In the first class were the sugar, brewing, glass, porcelain and paper and pulp industries. The iron, steel, engineering, chemical and allied trades were partly dependent on imports and the textile trade was wholly dependent for its raw goods from abroad. At present there were 84 Research Institutes concerned with the problems of the various industries and this was an indication that Czechoslovakia was intent upon developing its resources to the fullest extent. At present only ten per cent. of the water power had been harnessed but during the eleven years of its existence the State had made progress in all directions.

It is reported that a new radium mine has been opened near Jachymov in Czechoslovakia.

U.S. TRADE SLUMP UNLIKELY TO AFFECT GREAT BRITAIN.

Special interest attaches to the current number of the Federation of British Industry's Economic Supplepent, which takes the view that this is not an isolated phenomenon but a major movement which must also affect American industry and employment. In other words, the world is at the culmination of what in the pre-war period was known as a " Trade Cycle " movement.

While the main force of the movement will be centred in the U.S.A. it is likely to have widespread reactions on trade and industry all over the world. It is impossible at the moment to foresee how far this movement will go but there is no reason to anticipate that so far as Great Britain is concerned it is likely to be either prolonged or severe.

The Supplement discusses the international complications which led up to the present crisis and draws attention to certain important elements of international reorganisation which are necessary to restore stability and make it possible for world trade to move forward as in the days before the war.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

November 7.

Papers read :—

The Remarkable Adaptation by which a Dipterous Pupa (Tubanidæ) is Preserved from the Danger of Fissures in Drying Mud. By W. A. Lamborn. Communicated by E. B. Poulton, F.R.S., who read the paper.

The Absorption of Light by the Coloured Globules in the Retina of the Domestic Hen. By H. E. Roaf. Communicated by Sir Charles Sherrington, F.R.S.

Studies of the Growth of Moulds.—I. By R. G. Tomkins. Communicated by Sir William Hardy, F.R.S.

When moulds are germinating on a substratum or soil, in equilibrium with the atmosphere, it has been found :—

(1) At any given temperature rate of germination, whether measured by time taken for germ tubes to appear or by subsequent rate of elongation of germ tubes, decreases as humidity decreases.

(2) Rate of germination is greatest at an optimum temperature, varying for different fungi. The further removed the temperature is from the optimum the slower the rate of germination.

(3) The range of humidities over which germination is possible varies with temperature. It is greatest at the optimum temperature, the further from which the narrower the range of humidities allowing germination.

(4) Rate of germination and range of humidity allowing germination are independent of surface, provided this surface provides nothing assimilable to the spores.

(5) If the soil contains nutrients, rate of growth and range of humidity and temperature within which growth is possible, are increased.

(6) The relation between growth of a "colony" and temperature, humidity and nutrient, resembles qualitatively that found for germination of spores.

The Morphology and Cytology of Bacterium Malvacearum E.F.S. By R. H. Stoughton. Communicated by Sir John Russell, F.R.S.

The chief internal structure, the form and developmental changes of which have been closely investigated, is a deeply staining centrally placed body. In resting cells this structure is more or less spherical and homogeneous; during division of the cell body, however, it undergoes division into two, of which one passes into each of the daughter-cells. The evidence strongly suggests that these structures, which can be observed in the living cells and their division watched, are of the nature of nuclei.

The new growth-forms, the mode and conditions of formation of which have been demonstrated, are of two kinds. The first presents the appearance of a very small deeply staining granule, which is produced in or adherent to the cell membrane, and liberated subsequently either by simple extrusion or by growth of a stalk formed apparently from the membrane of the cell. These bodies are apparently identical with the "gonidia" of other writers.

On the Coagulation of Muscle Plasma. By E. C. Smith. Communicated by Sir William Hardy, F.R.S.

The preparation and properties of a liquid expressate of muscle, representing as nearly as possible the living plasma, are described. It is shown that gelation occurs in such an expressate only when a trace of a neutral salt is added to the finely divided muscle in the frozen state.

Experiments are described which indicate that the gelation of the plasma and the hardening of the muscle in rigor mortis are one and the same phenomenon.

It is shown that changes in hydrogen-ion concentration are irrelevant to the process of gelation.

Papers read in title only :—

Ecology, Bionomics, and Evolution of the Torrential Fauna, with Special Reference to the Organs of Attachment. By S. L. Hora. Communicated by J. H. Ashworth, F.R.S.

The Swelling of Fish Skins in Solutions of Inorganic and Organic Acids. By J. C. Kernot, J. Knaggs, and Madge Kaye. Communicated by Sir William Hardy, F.R.S.

Anaerobic and Aerobic Activity in Isolated Muscle. By A. V. Hill, F.R.S., and P. Kupalov.

Life-History, Cytology and Method of Infection of Plasmodiophora brassicae *Woron, the Cause of Finger-and-Toe Disease of Cabbages and other Crucifers.* By W. R. I. Cook and E. J. Schwartz. Communicated by E. J. Butler, F.R.S.

On the Development of the Vertebral Column of Anura. By H. K. Mookerjee. Communicated by E. W. MacBride, F.R.S.

On the Development of the Vertebral Column of Urodela. By H. K. Mookerjee. Communicated by E. W. MacBride, F.R.S.

Megasapore Development in Oenothera rubricalyx. By R. R. Gates and F. M. L. Sheffield. Communicated by Sir John Farmer, F.R.S.

Monomolecular Films of Irradiated Ergosterol in Relation to the Production of Vitamin D. By O. Rosenhain, F.R.S., and N. K. Adam.

Effect of X-Radiation on the Spermatogenesis of Lepisma domestia. By R. N. Mukerji. Communicated by J. P. Hill, F.R.S.

Various cytological changes take place in the cytoplasmic inclusions of the developing male germ-cells. The Golgi bodies in the spermatocytes approach the nucleus, swell up and fuse in various ways. Precocious formation of the acrosomic granule sometimes occurs. The mitochondria and their

derivative, the *nebenkerne*, undergo various alterations in the spermatids. The vacuolar system remains unaffected, and the other elements of the testes, *viz.*, the nurse-cells, show no definite changes.

The Effect of X-Radiation on the Spermatogenesis of Abraxas grossulariata. By J. B. Gatenby, R. N. Mukerji and Sylvia Wigoder. Communicated by J. P. Hill, F.R.S.

November 14.

Papers read :—

The Structure and Activation of the Molecule of Phosgene. An Analysis of the Ultra-Violet Absorption Spectrum of Phosgene Vapour. By V. Henri. Communicated by T. M. Lowry, F.R.S.

A Photographic Method of Measuring Refractive Indices. By T. M. Lowry, F.R.S., and C. B. Allsopp.

Infra-Red Investigations of Molecular Structure. III & IV. By C. P. Snow and E. K. Rideal. Communicated by T. M. Lowry, F.R.S.

A Flow Method for Comparing the Specific Heats of Gases. By P. M. S. Blackett, P. S. H. Henry and E. K. Rideal. Communicated by Sir Ernest Rutherford, P.R.S.

THE CHEMICAL SOCIETY.

Thursday, November 7.

The Nitration of Aromatic Thiocyanates.

By F. Challenger, C. Higginbottom, and A. Huntington.

The nitration of phenyl thiocyanate yields a mixture containing 80 per cent. of *p*- and 20 per cent. of *o*-nitrophenyl thiocyanate as estimated by determination of setting points.

o-Chloro, *o*-bromo, and *m*-chlorophenyl thiocyanates were prepared and nitrated. The *o*-compounds yielded a mixture of 4-nitro- and 5-nitro-*o*-chloro-(or bromo-)-phenyl thiocyanates, the former isomeride being the main product in both cases. The *m*-derivative gave a mixture of 6-nitro- and 4-nitro-*m*-chlorophenyl thiocyanate, the latter being the major product. These results indicate the strong *para* directing influence of -SCN. The nitro-compounds are easily converted into the corresponding disulphides by alkali.

Further attempts to nitrate *p*-iodophenyl thiocyanate have proved unsuccessful, iodine and *p*-nitrophenyl thiocyanate being formed. In other cases no reaction occurred with nitric acid, the iodophenyl thiocyanate being recovered unchanged. Chlorination of *p*-iodophenyl thiocyanate yielded an iododichloride, but attempts to decompose this under various conditions in order to induce the chlorine to enter the nucleus were unsuccessful, loss of chlorine and regeneration of the thiocyanate taking place in most cases. When slowly decomposed by sunlight, *pp'*-di-iodophenyl disulphide was formed, and in this and in the other cases no chloro-substitution products could be found.

The Oxidation and Nitration of Phenylboric Acid. By F. Challenger and A. D. Ainley.

A study of the properties of phenylboric acid $C_6H_5B(OH)_2$ has been undertaken with special regard to its behaviour towards oxidising agents. The reactions with chlorine water, bromine water, iodine in potassium hydroxide, hydrogen peroxide, mercuric chloride, and mercuric bromide proceed readily at the ordinary temperature giving halogenobenzenes, phenol, mercury phenyl chloride, and mercury phenyl bromide. In the case of cupric chloride and cupric bromide the reaction is aided by heat, chloro- and bromo-benzene being obtained. The boron is eliminated as boric acid.

Phenylboric acid is unchanged after long boiling with 5 per cent. sodium hydroxide, but readily gives benzene with hot 50 per cent. solutions, or on heating with water under pressure.

Its nitration has been effected with nitric and sulphuric acids at -20°, the *m*-nitro-derivative being almost exclusively produced. Its orientation has been determined by treatment with mercuric chloride, cupric chloride, cupric bromide, bromine water, and hydrogen peroxide. The ease with which the phenyl group is eliminated from its union with boron recalls the behaviour of triphenylbismuthine and of mercury diphenyl. The action of these substances on cupric halides has been studied. The reactions are analogous to those of phenylboric acid, thus :—

$$C_6H_5B(OH)_2+H_2O+HgX_2=C_6H_5HgX+HX+B(OH)_3$$

$$(C_6H_5)_3Bi+2CuX_2 = (C_6H_5)_2BiX+C_6H_5X+Cu_2X_2$$

$$(C_6H_5)_2Hg+2CuX_2 = C_6H_5HgX+C_6H_5X+C_6H_5X$$

The Oxidation of a-Terpinene with Perbenzoic Acid. By L. A. Elson, C. S. Gibson and J. L. Simonsen.

**The Constitution of Crystal.* By A. R. PENFOLD AND J. L. SIMONSEN.

The aldehyde, aromanderal, the separation of which from various eucalyptus oils was described by Smith (*inter al.* Trans. Royal Soc. South Australia, 1916, XL, 485) has been found by Penfold to be a mixture of cuminaldehyde, phellandral, and cryptal (J., 1922, CXXVIII, 266). Cryptal is now shown to be 4-*isopropyl*-Δ^2-cyclo-*hexenaldehyde* since on oxidation with potassium permanganate it yields *d*-α-*iso*-propylglutaric acid. The mechanism of the oxidation is discussed and attention is directed to the biogenic relationship of α-phellandrene to phellandral and cryptal.

THE PHYSICAL SOCIETY.

At the meeting held on Friday, November 8, a lecture was delivered by Prof. Sir C. V. Raman, F.R.S., on *Diamagnetism and Molecular Structure.*

A paper entitled *The Transverse Velocity Gradient near the Mouth of Pipes in which an Alternating or Continuous Flow of Air is Established*, by E. G. RICHARDSON, B.A., Ph.D., D.Sc., and E. TYLER, M.Sc.

A paper entitled *Resolving-power Tests on Microscope Objectives Used with Ultra-Violet Radiation*, was read by B. K. JOHNSON, F.R.M.S.

A paper entitled *Some Additional Lines in the Secondary Spectrum of Hydrogen*, by F. C. CONNELLY, A.R.C.S., B.Sc., D.I.C., was taken as read in the absence of the author.

INSTITUTION OF CIVIL ENGINEERS.

PRESIDENTIAL ADDRESS BY W. W. GRIERSON, C.B.E.

The President, after referring to the fact that his presence in the Chair was due to the inability of either of the two senior Vice-Presidents (Sir John Snell and Sir George Humphreys), owing to pressure of official duties, to accept nomination for election to the Presidency for the present session, stated that he proposed to follow the practice of former Presidents in dealing with the branch of engineering work with which each had been associated during his career.

Taking, therefore, transport as the general subject of his address, he dealt first with the history and present state of railway and canal transport. Industrial depression, road motor competition, the development of air services, and depleted revenue drew attention to the change in conditions which formerly caused railway securities to be regarded as one of the soundest of industrial investments; and it was not improbable that in some minds the fear had arisen that the days of railways as successful commercial undertakings were numbered, and that their ultimate fate would resemble that of the canals which preceded them.

In the middle of the eighteenth century roads were miry lanes, fords were common, and the conditions were such that transport of goods was largely done by pack-horse. It was not until the early years of the nineteenth century that improvements in roads led to their general use for the conveyance of freight. Well before that time, however, natural waterways, and later canals, were the principal means of transporting bulky and heavy goods. The rapid development of canals was largely a result of the success of the Bridgewater canal, sanctioned in 1762. It was probable that the prosperity of the canals, some of which at one time yielded dividends of 100 per cent. per annum, was instrumental in hastening the advent of railways; for the proprietors, being subject to no control in respect of tolls, and believing that they held a monopoly, were unwilling to reduce their charges. The first effect of the railays, which, unlike the canals, were not affected by shortage of water or frost, was a great deduction in the charges for canal transport, rather than in the volume of water-borne traffic.

It was difficult for a railway engineer whose duties included the supervision of canals to see any hope that canal transport, in general, would prove economical to-day in England. A substantial number of the original canals were derelict, and the remainder were not prosperous. It was questionable whether useful comparison could be made with canals on the Continent, where geographical, physical, and political conditions were so different. In Belgium and Germany both canals and railways were State-owned, and the policy had been to foster water-borne traffic. It seemed that any State-aided scheme for the improvement of transportation in Great Britain would be more likely to succeed if it assisted the railways rather than a system that was nearly obsolete in this country.

The President referred to the development of rail track from the earliest examples to the latest types, and suggested that modification in the proportions of the constituents of ordinary steeel rails and the development of special steels and processes of heat treatment presented scope for a possible lengthening of the life of rails. The standard gauge of 4ft. 8½in. was probably a legacy from the earliest plate-ways built to take an ordinary country cart. Brunel considered that high speed on the alignment followed by the Great Western Railway would be obtained most safely and economically by the use of a broader gauge; and a Royal Commission, appointed in 1836, recommended a gauge of 6ft. 2in. for railways in Ireland, for reasons similar to those which had influenced Brunel. Nevertheless, want of uniformity finally led to the scrapping of the broad gauge in Great Britain. The seriousness of the gauge problem was now fully recognised in Australia, where the main trunk lines were of three gauges, which involved numerous and costly delays and trans-shipments. In India, where the important centres were directly connected by through routes, the problem was of less moment. The South African railways demonstrated in a remarkable manner, largely due to development in the last few years of locomotive power, the capacity of the 3ft. in. gauge for dealing with heavy traffic at high speed and for providing very comfortable passenger accommodation.

With regard to railway electrification, while the superiority of electric traction on suburban lines had long been established, it was doubtful whether it would prove economical for main lines in this country. Statistics relating to European railways showed that electric traction was adopted on main lines largely where the availability of water-power, the non-existence of native coal, and steep gradients favoured the electric locomotive.

As a successor to Brunel as Chief Engineer of the Great Western Railway, it was appropriate that he should refer to Brunel's more important works. One of these, the Maidenhead brick arch bridge, was peculiarly graceful, the two main arches being semi-elliptical, with a span of 128ft. Brunel rarely used piled foundations, preferring apparently to rely on a large bearing-area. Prob- the timber viaducts in South Wales, Devon, and Cornwall would rank among his boldest, and most pleasing designs. His preference for timber was probably due to its cheapness compared with wrought-iron, and he never had a high opinion of cast iron as a material for railway bridges.

When the South Devon railway was projected in 1884, the question of motive power for use on very steep gradients arose. Brunel, in recommending the adoption of the atmospheric system, considered that stationary power, if freed from the weight and friction of a rope, would be cheaper and more flexible than locomotive power. The abandonment of the system after 12 months was not due to lack of speed or power, but to its high working-cost, resulting from the low efficiency of the steam-engines, and mechanical defects in the atmospheric valve

No attempt to sketch the development of transport would be complete without reference to the remarkable progress of transit by air. In considering the advances made during the last century in commerce and relationship with distant countries as a result of new means of transport, it might well be wondered what new developments the future had in store. No limit to progress had yet been set; and distance, as a commercial and political factor in the intercourse of nations, was gradually being eliminated.

SOCIAL SCIENCE RESEARCH SCHOLARSHIPS.

The Social Science Research Training Committee, under the chairmanship of Sir Josiah Stamp, has made the following awards of £60 scholarships for the academic 1929-1930, and renewable for the year 1930-31 :—

Miss Portia Holman, of Cambridge and Paris Universities, whose subject is "'An Investigation into the Mentally Deficient in Industry."

Mr. J. C. Gilbert, London School of Economics, who is to study "Central Banking Policy since the Stabilisation."

Mr. Brinley Thomas, University of Wales, who is investigating "The South Wales Coal Trade from 1900 to Date."

Mr. H. R. E. Greaves, London School of Economics, on the condition that his subject of research—namely, "The Constitutional Code"—is brought as far as possible under realistic and objective tests.

INSTITUTION OF CHEMICAL ENGINEERS' RECEPTION.

The annual president's reception of the Institution of Chemical Engineers was held on 6th inst., at the Princes' Galleries, W.1. Nearly 500 guests were received by the president, Mr. J. Arthur Reavell, and Mrs. Reavell.

Forthcoming Events.

ROYAL STATISTICAL SOCIETY.

The first Ordinary Meeting of the present Session will be held at 5.15 p.m., on Tuesday, November 19, in the Hall of the Royal Society of Arts, John Street, Adelphi, W.C.2, when Prof. J. H. Jones, M.A., of the University of Leeds, will read a paper on "" The Present Position of the British Coal Trade."

Synopsis.—Limitations of statistical data relating to prices and wages. Statistical measurement of elasticity of demand. Comparison of pre-war and present production and exports. Examination of trade with regional markets. Competition of Poland and Germany. Export trade of producing districts within Great Britain. Changes in coastwise trade. Effects of changes in relative wages of producing districts. Conclusions.

THE BRITISH SCIENCE GUILD.

"Medical Research : The Tree and the Fruit," is the title of the Norman Lockyer Lecture of the British Science Guild, to be given on 19 November, by Sir Walter Morley Fletcher, C.B., K.B.E., M.D., Sc.D., F.R.S.

The Lecture will be given in the Goldsmiths' Hall, Foster Lane, E.C.2. (by permission of the Goldsmiths' Company) at 4.30 p.m.

Tickets of admission (free) may be obtained on application to the Secretary, 6, John Street, Adelphi, W.C.2.

Friday, November 29.—" The Abatement of Domestic Smoke. By Marion Fitzgerald, *Associate Royal Sanitary Institute.*

Friday, December 6.—" The Abatement of Industrial Smoke." By R. Morton Rowe, Chief Smoke, Chemical, and Technical Inspector, Public Health Department, Manchester.

Friday, December 13.—" General Aspects of the Smoke Problem. By Arnold Marsh, M.Sc.Tech.

THE INSTITUTE OF PHYSICS.

Wednesday, November 27, at 5.30 p.m.—" Physics in Relation to the Utilisation of Fuel." By Dr. C. H. Lander, C.B.E., Director of Fuel Research, Department of Scientific and Industrial Research. The lecture will be given in the Rooms of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2. The chair will be taken by Dr. W. H. Eccles, F.R.S., President of the Institute of Physics.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

A meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, 20 November, b1929, at 7.30 for 8 p.m. The following papers will be read and discussed :—

" *Dicranophorus hudsoni* (Glascott)." By Dr. P. de Beauchamp, D.Sc.

" Sarcocytis in Human Heart Muscle " By Dr. J. A. Hewitt,. D.Sc., Ph.D., A.I.C.

" The Projectograph. An Optical Instrument for the Projection of Images of Microscopical Objects. By Mr. T. E. Wallis, B.Sc., F.I.C., F.R.M.S.

The Biological Section will meet in the Library on Wednesday, 4 December, 1929.

UNIVERSITY COLLEGE, LONDON.

Monday, November 18, at 2 p.m.—" Alchemy and the Alchemists." A public lecture by Dr. Oscar L. Brady.

Monday, November 18, at 5.30 p.m.—" How London Became the Capital of England." First of a course of five public lectures by Miss E. Jeffries Davis, F.S.A. November 18, 25, December 2, 9 and 16.

Tuesday, November 19, at 5.30 p.m.—" Some Administrative Difficulties of Army Mechanisation." A public lecture by Col. D. C. Cameron, O.B.E., Commandant of the R.A.S.C. Training College, Aldershot. Chairman : Lieut.-General Sir Hastings Anderson, K.C.B.

INSTITUTE OF RUBBER TECHNOLOGISTS.

Manchester Cafe, Ltd., Exchange Buildings.
Thursday, November 21.—" Unburstable Balls." By R. Defries.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.
Wednesday, November 20, at 8 p.m.—P. Morley Horder, F.S.A.: " The Protection of Rural England."

Publisher's Announcements

The following Books can be obtained from Rea and Inchbould, Merton House, Salisbury Square, London, E.C.4. :—

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NEUTRONS AS FACTORS IN THE TRANSFORMATION OF MATTER INTO RADIATION.

By F. H. LORING.

PART I.

Present-day physicists favour the idea that the components of the atom are positive and negative electricity, and that these two 'opposites' called protons and electrons respectively, could when in very intimate association completely neutralise each other; and, since matter is composed only of atoms, and atoms in turn are composed only of electricity, as just stated, when this neutralisation takes place the matter as such disappears and a corresponding amount of radiation is generated. The energy appearing as radiation, according to Einstein's equation, is $mc^2 = E$, m being the mass transforming into radiation, c the velocity of the radiation, *i.e.*, the velocity of light, E the energy in ergs.

Attempting a moving picture of this phenomenon, the electron occasionally falls into the atomic nucleus and completely neutralises a proton there, giving rise to an outburst of radiation of short wave-length and high frequency.

That the atom is an electric structure has been proved by an enormous accumulation of experimental data, but the transformaton of mass (matter) into radiation is without direct experimental verification, though there is a considerable amount of pointer evidence, so to speak, that leads directly to such an interpretation.

The following is another way of elaborating the above idea. In this connection it is important to note that stellar radiation is so intense and vast in amount and so long in duration that it cannot be ascribed to chemical action even if accompanied by the generation of energy by the gravitational falling in or consolidation of the *sun's* mass —to take the nearest star as an example.

Since the nuclei of all atoms except hydrogen are supposed to contain protons that are cemented together by nuclear electrons, the dissolving of matter into radiation is possibly a transaction involving *nuclear* protons and *nuclear* electrons.

Considering what happens in stars, in their central regions the gravitational pressure is very great, and in such cases conditions would seem favonrable for the cementing electrons to merge with their companion protons and to give rise to joint annihilation with a consequent outburst of high-frequency radiation. This radiation in passing out through the body of the star becomes

degraded into lower-frequency longer wavelength radiation, as observed spectroscopically—an idea Sir James Jeans has expounded in his recent writings.

Now the question to be raised here is: What are the precise conditions necessary to bring about this annihilation of matter and concurrently its transformation into radiation? As in radioactivity, there is posssibly a nuclear condition arising from some chance coincidence in the time process, whatever that may be. If, in the first place, all the outer electrons of the atoms are stripped off, owing to the very high temperature in the interior of the star, then the bare nuclei would come closer together, as Eddington has pointed out. These nuclei would then suffer much harder impacts than would be the case with a highly elastic shell of protecting electrons—as is ordinarily the case with terrestrial atoms under more or less normal conditions—if it were not for the intense positive field round each nucleus shielding it to some extent from easy approach or attack from another like nucleus approaching it, as like charges repel each other.

If it were not for the field difficulty, here mentioned, hard enough impacts might occur which would cause the colliding nuclei to coalesce and give out high-frequency radiation whenever their protons and electrons were driven into each other by the collision.

That collisions in such cases need not involve a rebound of the nuclei colliding, is made partly evident by the famous experiment of Blackett (*Proc. Roy Soc.*, 1925, *A 107*, 349), in which a high-speed alpha particle, from the deposit of ThC′ and ThC stuck fast to a nitrogen nucleus when a proton or hydrogen nucleus (*i.e.*, H without its normally attendant electron) was driven out by the square-on impact of the alpha particle, the C. T. R. Wilson condensation-cloud photographs showing the tracks very clearly, these tracks being the trajectories of the atoms. All tracks were recorded, but the rebound one of the alpha particle was absent, thus explaining the attachment.

Returning to the main part of the argument, the above idea admits of further development which would seem to overcome the charge difficulty. Consider a proton and an electron so closely associated as to form a neutral doublet called a *neutron*. This would have no appreciable external field and would have remarkable properties, as Sir E. Rutherford has pointed out in his Bakerian Lecture delivered before the Royal Society on June 3, 1920 (Proc. Roy. Soc., 1920, *97*, 374). Consider neutrons instead of stripped atoms (nuclei), coming into hard contact as brought about by the high temperature-pressure conditions prevailing in the centre of stars. The above annihilation would then seem far more likely to take place than in the former case.

The steps in the process may be as follows:—

1.—Free electrons and free protons.

2.—These united as neutrons in the atomic nuclei—at least some neutrons would be formed.

3.—Thermal agitation separating the neutrons so that they can move about as independent units.

4.—Neutrons striking together and suffering annihilation or perhaps an element of atomic number zero is formed, which gives rise to a high-frequency radiation.

It should be borne in mind that the above steps may be expanded so as to include protons cemented by electrons which are not strictly speaking neutrons, the idea being to arrive by stages at the ultimate one—*the disappearing act, or the apparent disappearing act.*

Now it will doubtless occur to the reader that since in the stars there are free protons and free electrons, Why should they not rush together under their mutual attraction and completely disappear giving out in consequence flashes of radiation? This may be the current view, but when considering the geometry of the case, the enormously spreading fields round protons and electrons present difficulties. How are these fields to come together so as to neutralise each other in one single act? The point here is that while this might be possible under certain conditions, it seems more in the nature of things, that the process is a step one as intimated above.

I have not seen the matter stated in the above ordered way, and I believe that the *neutron idea* in this connection is new.

Stephen Miall was evidently the first to develop the idea of neutrons within the atom, as they corrrespond to the "ballast," as will be seen presently. Prof. Sir J. A. Fleming in his ELECTRONS, ELECTRIC WAVES AND WIRELESS TELEPHONY (1923), pp. 123-127, puts the whole matter very clearly, as will be seen from the following:— "We can also attach to each element a number called its *Atomic Number* . . . which represents its numerical order of the elements in the series . . .

"It is seen that at the beginning of the series the atomic weight is about double the atomic number . . .

zero or a small number. At the end of the series there is, however, a great difference between the atomic weight and double the atomic number.

" Mr. Stephen Miall, in his little book on THE STRUCTURE OF THE ATOM (Benn Bros., London), has pointed out that the atomic weight w is related to the atomic number n in the manner expressed by the formula $w = 2n + b$, where b may be called the dead weight or ballast.

" Van den Broek made the suggestion, adopted now very generally, that the atomic number represents the resultant number of positive electrons [protons] in the nucleus, or what is the same thing, the number of planetary electrons circulating round it in a neutral atom [Moseley's X-ray spectra of the elements support this idea].

" Thus the nucleus of the helium atom consists of four positive electrons [protons] bound together by two negative electrons. The resulting positive charge is then 2 units. The atomic number of helium is two, and its atomic weight . . . nearly 4. It has two negative electrons which circulate round the nucleus. In this case the ' ballast ' weight is zero. In the case of uranium, however, the atomic number is 92, the atomic weight is 238.2. Hence the ' ballast ' is 54.2."

It is necessary to quote further here as the isotopic principle must next be considered.

" One important thing discovered is that the chemical properties of the atom are more closely related to the atomic number than to the atomic weight. In short, it is possible to have atoms of identical chemical properties but different atomic weights. These atoms have been named by Professor Soddy *isotopes* . . ."

It is clear that the dead weights play no chemical part, but I will quote further.

" Take, for instance, the atomic weight of chlorine, which is 35.46. when that of oxygen is 16. The weight of the atom chiefly resides, as we have seen, in the positive electron [proton], and there must be an integer number of these positive electrons [protons] in the nucleus. The suggestion has therefore been made that there are two kinds of chlorine atoms, or two isotopes, one with an atomic weight of 35, and the other with an atomic weight of 37. They both have the same chemical properties, and ordinary chlorine gas is a mixture of these two kinds of chlorine atoms in such proportions that the average atomic weight is 35.46.

" *The explanation of this may lie in the fact that small variations in the ballast weight of the atom may take place without variation in the atomic properties* [the italics are mine]. Thus the atomic number of chlorine is 17. One kind of chlorine atom has an atomic weight of $35 = 2 \times 17 + 1$, and the other isotope is $37 = 2 \times 17 + 3$, and 1,300 atoms of ordinary chlorine gas comprise about 1,000 atoms weighing 35 and 300 weighing 37 units, equivalent to 1,300 in all, weighing 35.46 on an average."—Page 125. The original should be studied as I have limited the quotation to cover only the ballast idea and cognate subjects.

A good deal of the above is now elementary knowledge, but the ballast idea is worthy of note here. Miall in his little book (*loc. cit.*) on page 11 says :— " We must conclude from these facts that, in addition to the nuclear mass, which is capable of losing a considerable number of helium atoms [referring to radioactivity], there are external electrons causing valency, middle electrons, capable of coming to the outside when sufficiently stirred up, and probably electrons lodged on or very close to the nucleus. I suppose an electron actually lodged on the nucleus would counteract the effect of one of the positive charges of electricity of the nucleus, and thereby bring two units of the nucleus into the state of dead weight which I dealt with in the articles already mentioned." They are in—*Chemical Age* (of London) Feby. 14, 1920; and April 3, 1920; respective pages 168, 350.

It was Sir James Jeans* who in 1904 suggested that the rushing together of positive and negative charges might afford sufficient energy to account for the enormous output of stellar energy, and in this case matter as represented by the charges is supposed to dissolve into radiation, as already explained. Jeans now believes that heavier atoms than uranium exist in the centre of stars. This would mean evidently a good deal of dead weight and perhaps a large supply of neutrons, so that material for generating radiation, according to the above view, is thus provided.

It is of historical interest to record here that Sir Isaac Newton in his OPTICKS (Book III, Quest. 30) said :— " Are not gross Bodies and Light convertible into one another, and may not Bodies receive much of their Activity from Particles of Light which enter their Composition ?

" The changing of Bodies into Light, and Light into Bodies, is very conformable to the Course of Nature, which seems delighted with Transmutations."

* *Nature*, 1904, *70*, 101.

I feel that I have only nibbled at the problem but, to quote Sir Oliver Lodge, "mice may nibble where lions feed."

There is a *counter argument* which, though it has not been put forward by physicists—as has the annihilation hypothesis—it is nevertheless of possible interest. This will be published later as Part II. I may have one or two amendments to offer as the study proceeds, and some further references to literature will be added.

REMOVAL OF DISSOLVED GASES FROM LIQUIDS BY VACUUM SUBLIMATION.

By James H. Hibben.

(*U.S. Bureau of Standards.*)

The complete removal of dissolved gas from a liquid is usually the final step in the purification of the liquid for the purpose of determining certain of its physical properties. Removal by chemical means is often impracticable, particularly in the case of the gases of the atmosphere. The collection of the dissolved gas for analytical purposes is also of importance, for example, in determinations of gas solubilities. The general physical method of purification described below not only permits the complete removal of the dissolved gas, in most cases, but also allows an approximately complete recovery of both the gas and liquid.

The methods described in the literature fall into four categories—those employing vacuum, those employing heat, those employing both vacuum and heat, and those employing freezing.

Unfortunately little information is available as to the relative effectiveness of these processes. Heating alone does not prevent the re-solution of the atmospheric gases on cooling, unless special precautions are taken, and it results in a partial loss of the liquid. Evacuation alone involves a similar loss of liquid, and only a partial removal of the total gas content if a constant boiling mixture is formed. Heating combined with evacuation is more effective, although the manipulation is generally inconvenient. The vacuum attainable is limited by the vapour pressure of the liquid at the temperature of condensation, so that the rate of removal is low. There is some loss of liquid, and a constant boiling mixture can not be completely freed from gas. Freezing, alone, is somewhat effective only in the removal of the permanent gases.

The vacuum sublimation process here described, includes all the processes named above, since it employs heat, vacuum, and freezing.

The liquids to be freed from gas are vaporised and frozen in vacuo. While the use of vacuum sublimation as a possible means of purification is not new, there are certain experimental requirements which must be met, otherwise little purification will result. These have not been heretofore discussed.

The conditions essential to the best operation of the process of purification by vacuum sublimation are as follows: (*a*) The temperature at the condensing surface must be considerably below the freezing point of the pure liquid to that its vapour condenses directly to a solid, otherwise a resolution of the gas impurity may occur if a liquid phase is present at the condensing surface during condensation. (*b*) The sublimate must have a negligible vapour pressure at the temperature of condensation or a loss of the pure material will result. (*c*) The third condition can be stated in the following general form: The vapour pressure of the impurity from any system containing it which can exist on the condenser must be greater than the partial pressure of the impurity in the gas phase. The following are possible systems of this kind: (1) A liquid phase in equilibrium with the sublimate. Such a system can form only above the eutectic temperature and for a given condenser temperature only if the partial pressure of the impurity in the gas phase exceeds a certain fixed value characteristic of the system. (2) The solid impurity. (3) Mixed crystals containing both sublimate and impurity. (4) Adsorbed impurity.

Condition (4) can never be realised since for every pressure of the impurity in the gas phase some adsorption on the condensate is possible. This difficulty is usually of secondary importance, however, and its effect can be made as small as desired by repeated sublimations. The contamination resulting from (3) is likewise reduced by successive sublimations.

The partial pressure of the impurity in the gas phase may be reduced by continuous pumping. The limiting total pressure thus obtainable is the vapour pressure of the sublimate. For example, with water as the liquid to be purified, NH_3 as the impurity, and a condensation temperature of $-78°$ C., the minimum total pressure obtainable is 0.001 mm Hg. The partial pressure of NH_3 from its aqueous solution in equilibrium

with ice at this temperature is of the order of a millimeter. Condition (1), therefore, can not occur and purification results. *Similarly with CO_2 and O_2 as impurities*, the water may be completely freed from gas.

A different circumstance is met, however, if HCl is the impurity. The partial vapour pressure of HCl from its aqueous solution in equilibrium with ice at -78° C., is much less than 0.001 mm Hg, and conditions (1) may occur. Part of the ice melts and a resolution of HCl occurs.

In the experiments here described, NH_3, HCl, CO_2, and O_2 were chosen as gas impurities. For the most part water could, of course, be conveniently freed from these particular impurities by chemical means. They represent, however, types of gas impurities, the complete elimination of which has been heretofore, difficult by physical means.

ELEMENTS IN THE SUN.
(Second Note.)

In this Journal, present vol., page 244, the writer abstracted in part an article in the *Astrophysical Journal* of July, 1929, by H. N. Russell on the elements in the sun. C. E. St. John in the *Proceedings of the National Academy of Sciences, of U.S.A.*, October 15, 1929, vol. *15*, pp. 789-793, contributes a similar paper based upon the revision of Rowland's table of solar spectra wave-lengths, recently completed at Mount Wilson Observatory. Many additional lines have been identified with terrestrial elements. 58 elements out of 92 have been identified as being present in the sun, and there is no reason to doubt that all 92 elements will ultimately be found there in theory, if not in fact. As is well known some elements have their strong lines either in the ultra-violet or in the deep red region, and the earth's atmosphere absorbs the radiation of the former. Among the recent identifications are *atomic* C, N, O, and S; while Li, Rb, In, and boron oxide are limited to the sun-spots which are of lower temperature as compared with the other brighter parts.

The elements awaiting identification in the sun are :— F, Ne, P, Cl, Ar, As, Se, Br, Kr, Nb ?, Ma, Sn ?, Te, I, Xe, Ta, Re, Os, Ir, Au, Hg, Tl ?, Bi, Po, 85, 87, Rn, Ra, Ac, Th, Pa, U; and of the rare-earth metals : Il, Tb, Ho, Er ?, Tu, Yb, Lu.

It is probable that a number of heavy metals, particularly among those of the rare-earths, may be detected in the sun when more precise laboratory data are available and their spectra analysed. These will probably be represented by the fainter lines in the sun's spectrum.

There are several factors that have to be taken into account; and, though not mentioned by St. John, the breaking up of some of the atoms by bombardment, or by a high internal temperature-pressure, may affect the *quantitative* distribution. "An outstanding anomaly is the appearance of the ionised helium line λ4686 in the chromosphere. The ionization potential of 24.41 volts and an excitation potential of 48.16 give 72.57 volts required for the production of the line." St. John does not attempt an explanation of this extraordinary observation.

It should be noted that the above excitation seems confined to a relatively high layer in the sun's atmosphere, according to St. John. Treating the sun as a huge radioactive atom, the expulsion from its nucleus of alpha particles seems suggestive—an idea the writer intended to convey in some early writings. The reader must, however, be prepared to learn in the future of conditions in the sun not thought of even by those of a speculative turn of mind like the present writer of this abstract.

"Of note among the strong unidentified lines are 1 of intensity 7, 3 of intensity 5, and 6 of intensity 4 (W. S. Adams and A. H. Joy, *Mt. Wilson Comm.*, No. 99; or, *Proc. Nat. Acad Sci. of U.S.A.*, 1927, *13*, pp. 393-396). If, as seems quite certain, these strong lines are due to common elements, their identification promises to reveal exceptional conditions of excitation in the sun, as corresponding lines are not produced in the laboratory by present methods of excitation."

"The extraordinary strength of the hydrogen lines points to the extensive atmosphere of hydrogen shown by eclipse spectra."

F. H. Loring.

MEDICAL SUPPLIES FOR AMSTERDAM.

The Commercial Secretary at The Hague (Mr. R. V. Laming, O.B.E.) reports that the Netherlands Government is calling for tenders, to be presented in Amsterdam by the 3rd December, 1929, for the supply of pharmaceuticals, galenicals, drugs, chemicals and druggists' sundries.

Firms desirous of offering supplies of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number BX. 5877 should be quoted.

INDUSTRIAL RESEARCH.

" Industrial Research " was the subject of an address by Dr. F. A. Freeth, F.R.S., Joint Research Manager for Imperial Chemical Industries Limited, on Friday, November 1, to the Annual Joint Meeting of the Society of Chemical Industry, The Institute of Chemistry, The Society of Dyers and Colourists (Manchester Section), and the Manchester Literary and Philosophical Society.

" With certain well-known exceptions," said Dr. Freeth, " industrial research in Britain did not receive much serious attention until the close of the war. The average age of research departments either belonging to the State or to private companies is certainly less than twenty-five years. Therefore we are really dealing with a movement that is in its infancy.

" I propose to deal with the question of research not as confined to the chemical industry but as applicable to the general industries of the country as a whole. Industrial research had not too good a start as regards the mutual relationships of the parties concerned. Let us begin with the manufacturer who after all is one of the principal parties concerned, since it is he who has to pay for it. Manufacturers in this country have had a most anxious and uneasy time during the past seven or eight years, and there has been far too much general condemnation of the manufacturer's attitude to research. The word ' backward ' is constantly used. The approach to the manufacturer has not been correctly made. He has been urged to prosecute research merely on a paying basis, but I must insist that there is a great necessity for an almost paradoxical frame of mind in this connection.

" Let us now consider the second and very important party, namely, the technical staff. The technical staff of an old-established industry will nearly always be what are known as practical men, and their attitude of mind, without being hostile to research or to the scientific worker, is apt to be acutely critical, often for very good reasons.

" The research worker has advanced upon industry in the style of Joshua blowing his trumpet with the negative effect that the walls have not fallen over. Also the imposition of the cost of research upon the cost of manufacture is nearly always one which is to some extent resented by technical men of affairs. My point is that a great many of these difficulties can be overcome by a spirit of enthusiasm in intelligent scientific work. It must always be remembered that if you can convince the manager of a works that he has at his call a body of research workers who are actively and energetically investigating the inmost theories of their subject, you can ver often command results which will convert him from a sceptic into an enthusiast.

" As regards the research worker himself I must say that in some cases the scientific man has approached the problems of industry in an altogether too light-hearted spirit. One of the most important things in industrial research is the attitude of mind of the research worker.

" Let us then consider the position of any industry which up to the present has had very little assistance from research or has been averse from spending money on research on the grounds of financial stringency.

" Returning to our industry which is about to undertake research, we will assume that there are reasonable grounds for hope of improvement. This brings us to the crux. Research in an industry of this character—it must be remembered that by far the greater part of the industries of the country comes into this category—must be on the lines of finding out more about it and especially about the scientific mechanism of its processes rather than an attack on particular difficulties.

" This conception demands the utmost open-mindedness, sympathy and co-operation between the manufacturer on the one hand and his technical staff and his research workers on the other. This can best be appreciated by looking into that most important question, the condition of the minds of those actually engaged in doing research. Nearly every scientist or scientific worker has in his inmost heart a tremendous respect for the purely scientific and academic sides of his profession. It is also in this sense a regrettable fact that in many cases academic science does not always accord quite that amount of admiration and understanding to industrial science which is necessary in order for it to maintain its self-respect.

" When we examine the various statements made by great scientists and the facts of the conditions under which they worked, we find that independence of work and thought is the characteristic upon which they would most insist. If your research workers are always worried as to the production of what are called results you will inevitably destroy that free play of mind

which is so essential for the very difficult task of achieving the further development of an old-established industry.

"I am suggesting to you that the key to successful industrial research will be found in the development of the individual scientific enthusiasm of your research worker. There is all the difference in the world between a man who is filled with a kind of glorious obsession in his work and a man who is merely doing work in order to obtain a living. In many cases the conditions of an industry are such that it is nearly impossible for them to pay their scientific workers really adequately even if they cared to do so. I do not propose to elaborate that question, but I wish to impress upon you that a man must have some driving force behind him if he is to do good work. Monetary success is a tremendous incentive, but if you cannot get this, there is only one other thing possible and that is the stimulation of enthusiasm among your scientific workers by every means in your power.

"The research worker, like all of us, is subject to various cross currents of thought. A new phenomenon is arising; people are taking up industrial research as a means of livelihood. People are constantly asking me whether they shall make their son a physicist, a chemist or an engineer, the answer being supposed to be pre-determined by that profession in which he has the biggest chance of making a large income. This outlook produces a cross current in the mind of the scientific worker, which is very apt to lead him towards the executive administrational sides of the business.

"Claud Bernard, the famous French physiologist, in a striking passage emphasises the necessity of performing experiments without pre-conceived ideas. Many men whose whole lives and reputations have been connected with pure science have failed in this respect. How much more difficult is it, therefore, for the industrial research worker. Let us consider an average case of the training and environment of such a man. Nearly always he has been to a University, where in order to obtain a good degree it is necessary for him to cram like the proverbial Strassbourg goose. He next settles down for one or two years of research in the University of which he is already a member, though I consider that there is nothing more admirable for a man who has gained his degree at a University than to do his research somewhere else. During the two years' research our young man is at the mercy of another cross-current. Usually the research which he undertakes has not been suggested by himself, but is part of a general scheme worked out by the professor to whom he is responsible. The latter is under a kind of moral obligation to suggest a theme which will, as they say, come out, that is to say, which will yield some sort of result. This obviously means that very many of the interesting and more difficult ideas of science are neglected.

"Another cross-current is provided by changes of fashion, for you must remember that science runs in fashions. At the moment what you might call the fashionable theoretical trend is not particularly of immediate advantage to industry. I am not attempting to decry in the slightest the magnificent achievements of modern theoretical science; nevertheless, a great deal of modern chemistry and physics is remote from what you might call practical life.

"All this may sound a little depressing, but in fact it is not so. I have outlined the chief dangers merely to prove that if you recognise them they are the more easily overcome. Here are a few random suggestions. Research workers ought to travel and consult with other people a great deal more than they do at present, if only to prevent the almost endemic disease of mental staleness. The travelling accounts of many research associations are ludicrously small. A great deal also can be done by close association of trades which have nothing to fear from each other. Of course there has been in this country a kind of what might be called jealousy in the past, for instance of the necessity for secrecy. There are at this moment many research departments in different trades which could exchange complete information and mutual visits of staffs to the greatest good of everybody. It is also of the greatest value to stimulate and encourage friendly international relationships between scientific workers. Such exchange, and I have had a good deal of experience of it, is nearly always mutual, and its effect on industrial scientific workers is of the very greatest good."

ACTIVATED CARBON WANTED.

Messrs. Michelin, of Clermant-Ferrand, France, are anxious to get in touch with British firms manufacturing "Activated Carbon" which can be utilised for solvent recovery and other purposes.

GENERAL NOTES.

VISCOSE PROCESSES AND ALKALI RECOVERY.

In the preparation of alkali cellulose in the manufacture of Viscose rayon, sheets of cellulose are soaked in 18 per cent. sodium hydroxide solutions. The press lye recovered contains some 16 per cent. of alkali contaminated, however, with dissolved hemi-celluloses. In *Rayon Record* (current volume, p. 468) an account is given by G. W. van Barnveld Kooy of a method whereby the alkali may be recovered by dialysis with replaceable membranes since the alkali is still very concentrated. The article goes on to describe the construction, use, and performance of a modern type of industrial dialyser. The question of " idle flow " of the alkali on both sides of the membrane is also discussed.

PROF. A. F. HOLLEMAN'S JUBILEE.

On August 28 last Prof. Holleman, well known to two or more generations of students of organic chemistry, from his text-books which have been widely translated and have passed through many editions, celebrated his 70th anniversary.

As is customary on the continent the Netherlands Chemical Society have issued a special number of the *Receuil des Travaux Chimiques des Pays-Bas* (August) in honour of their distinguished member. This number of the *Receuil* contains nearly 300 pages and some fifty scientific communications from chemists all over the world. These papers, in the main, touch upon the field of chemistry in which Prof. Holleman was chiefly interested.

Sir James Irvine gives a short account of researches on the chemistry of Starch. The late Prof. C. Moureu contributed a paper " De l'acroléine à l'hémoglobine, en passant par les anti-oxygènes et les hydrocarbures colorés à peroxides dissociables (familee de rubrène)."

M. Gomberg deals with the reducing effect of the binary system (MgX_2+Mg) on organic compounds in anhydrous solvents.

Prof. P. Walden : Trichloracetic acid as a medium for cryoscopic determinations.

V. Grignard and Tchéoufaki : The additive properties of di-acetylene hydrocarbons.

M. T. Bogert and F. G. Hess : Benzothiazole arsenicals of the salvarsan type.

F. A. O. Schreinemakers : Osmosis in ternary liquids through a membrane permeable for two of the three substances.

F. Swarts : The orientation of substituents in the benzene nucleus.

W. P. Jorissen and B. L. Ongkiehong : The quenching of flames in atmospheres of a certain composition and at the limits of explosion regions.

The annual subscription for the *Receuil* is 16.50 florins (27s. 6d.)

THE WORLD'S HOP YIELD.

Preliminary returns already to hand indicate that the yield of hops has been everywhere very good this season. In Kent, Sussex, Hampshire and the west Midlands the crops have been well above the average. The quality is, however, not uniform, and whilst the total home-grown crop exceeds 359,000 cwts, and which may be in excess of requirements, the poorer qualities may be unsaleable. The exceptionally dry season may account for poorer qualities in some counties.

On the continent there have also been exceptionally heavy crops and low prices are the rule. The best quality hops are again those from Zatec (Saaz) in Czechosolvakia, where, although this year's yield is much in excess of last, a good price has been secured. Czechoslovak growers are probably alone on the continent in growers who have no difficulty in disposing of their hops. In Germany the quality is generally low, although the quantity is high. In Jugoslavia a good deal has been left standing as it does not pay for picking. Polish growers are also having difficulty in selling their hops, whilst French and Belgian growers will probably find a home market to take their, but at unusually low prices.

VOLCANIC DUST DEPOSITS IN WESTERN CANADA.

The *Canadian Mining Journal* of October 11 states that volcanic dust beds thirty feet thick are being worked in the deposits near Waldeck, eleven miles northeast of Swift Current, Saskatchewan. Extensive and pure deposits also occur on the Deadman River, thirteen miles north of Ashcroft, British Columbia, and on the east shore of Arrow Lakes, twenty-five miles south of Nakusp, British Columbia. Several other occurrences have been discovered in the vicinity of the Saskatchewan deposits. Volcanic dust is used for the manufacture of cleansers and scouring powders and in some instances as a substitute for fuller's earth in the refining of hard oils and fats.

CORRESPONDENCE.

TAR AND INDUSTRY.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—Mr. W. Thorne, in his letter published in your columns on November 8, describes bitumen as "foreign." I submit that this statement is without a shred of justification at the present time, whatever may have been the case eight years ago.

Of the bitumen used in this country 75 per cent. is British-refined, while the bulk of the remainder comes from Trinidad, and is therefore an Empire product. It is no more correct to describe bitumen manufactured in Great Britain from imported crude oil as "foreign" than it would be so to describe Lancashire piece-goods manufactured from imported raw cotton. There is, in fact, even less justification in the case of bitumen as the crude oil from which the bitumen is made is produced by British-controlled companies operating abroad, but largely staffed by Britishers. The transport of the crude oil employs in the course of a year 450,000 tons of British shipping, and has an important bearing on the prosperity of the shipbuilding industry. Last year 50 tankers for the transport of crude oil were completed in British shipbuilding yards.

The steel industry also benefits from the fact that the barrels for packed bitumen are made entirely of English steel and out of £5 10s. which is the average cost per ton of packed bitumen, 25s. represents payment for English steel barrels.

It is quite beside the point to compare the numbers employed in the gas industry with those engaged in bitumen-refining. The hundred thousand men claimed by Mr. Thorne for the tar industry are in fact only concerned with tar as a by-product, whereas if the sales of bitumen were to fall to any extent, thousands of men employed directly in its production would be thrown out of work. It is an indisputable fact that the manufacture of one ton of bitumen provides employment for a greater number of British workmen than does the manufacture of one ton of tar.

L. H. BROOKE.

Sir,—As one intimately acquainted with the conditions of our coke and tar industries, I appreciate the vital importance of the recent appeals made by Sir Henry Page Croft, Mr. Will Thorne, and other Members of Parliament for the use of British tar on British roads.

If, under the pressure of a vigorous sales campaign, our local authorities make it a practice to use foreign bitumen as a road dressing in place of British tar, their action will have a very serious effect, through the harm done to some of the biggest commercial buyers of coal, on our struggling coal industry.

The gas companies, for example, will find their whole mechanism of production crippled if they lose the home market for their output of road tar. Every penny per gallon received for road tar means £800,000 per annum to the gas industry. If this is lost, the consumer, the gas worker and the gas companies must all suffer, and the coal industry does not stand to gain from the troubles of one of its best customers.

In the coke oven industry, again, where coal is carbonised to yield crude benzol, sulphate of ammonia, tar and coke, every ton of coal carbonised yields nine gallons of tar. If the tar is sold at, say, 4d. a gallon, this produces a return of 3s. per ton of coal. If, on the other hand, the coke oven industry has its tar left on its hands as a waste product, it will lose the greater portion of this 3s. and be compelled, as a result, to force down the price paid to the pits for coal.

Similarly in the production of steel, the successful sale of road tar, as a by-product of the fuel used in manufacture, may actually mean a saving of five or six shillings a ton on the cost of steel—a saving which, in itself, may enable our steel manufacturers to capture foreign markets.

These facts are sufficient to show the enormous importance of road tar to industries which, between them, employ hundreds of thousands of men. As tar, refined to the standard specification of the Ministry of Transport, is to-day our most efficient road dressing, it is difficult to understand why, in so many cases, our local authorities are yielding to the blandishments of the sellers of foreign bitumen and so sacrificing our own industries. Those who advocate the use of bitumen talk in generalities of the amount of employment given in the few refineries established in this country, but so far they have failed to state how many men are actually employed, as compared with the vast number engaged in established industries which depend, directly or indirectly, on the disposal of tar.

Our roads are maintained out of taxes and rates, and it seems folly to spend any part of this money unnecessarily on such a foreign product as bitumen when British road tar is in urgent need of a market.

PHILIP B. NICHOLSON.

ONTARIO (CANADA) RESEARCH LABORATORIES.

The Prime Minister of Ontario recently laid the foundation stone of the new laboratory building established by the Ontario Research Foundation, which has been established to provide facilities for the investigation of problems concerning agricultural, industrial, mining and forest industries in that Province, has now accumulated funds aggregating about $4,000,000. Subscriptions from private individuals and organisations amount to $1,860,000, and as the Provincial Government has offered to subscribe one dollar for every dollar raised by the public, the Legislature has authorised the appropriation of $2,000,000, which will be handed over as soon as the remaining $140,000 comes in from private individuals. The control of expenditure will be in the hands of the Directors of the Foundation.

The Government is hopeful that the Ontario Research Foundation will be able to demonstrate the possibilities lying in the "sponge iron" produced from the huge quantities of low-grade ores available in the Province, but which have not yet been exploited, owing to the competition of imported high-grade ore from Minnesota.

The Chairman of the Council of the Ontario Research Foundation is Sir Joseph Flavelle, Dr. Horace B. Speakman being Director of Research. The entire faculty of the Foundation has been recruited from Canadian institutions. Dr. Speakman first went to Canada in connection with products not manufactured in the Dominion and needed by the British Ministry of Munitions. He has recently been released by the University of Toronto for the benefit of research work in Canada.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, November 14.

A special General Meeting was held to receive the Annual Report of Council, after which the following papers were read :—

The Structure and Activation of the Molecule of Phosgene. An Analysis of the Ultra-Violet Absorption Spectrum of Phosgene Vapour. By V. Henri and O. R. Howell. Communicated by T. M. Lowry, F.R.S.

The ultra-violet absorption spectrum of phosgene vapour has been protographed at pressures from 0.1 up to 680 mm. The complete spectrum consists of about 270 bands between 3,050 and 2,380 A. The absorption region is therefore the same as for all substances containing the CO group, but whereas with aldehydes and ketones the absorption reaches a maximum at about 2,800 A, with phosgene it increases continuously towards the ultra-violet.

The spectrum is purely vibrational, phosgene having such a large moment of inertia that the rotation spectrum is evident only as a broadening of the vibrational bands. The bands are degraded towards the visible, indicating that the moment of inertia is augmented by electronic activation.

The bands consist of doublets with a separation of 0.5 to 1 A, and of singlets distributed at regular intervals in the spectrum. The separation of the doublets increases towards the ultra-violet and they are attributed to the isotopes CO Cl^{35} Cl^{37} and CO Cl^{35} Cl^{35}, the latter giving the more intense band on the ultra-violet side.

As an aid to elucidating the ultra-violet spectrum, the Raman spectrum of phosgene was also obtained. It is composed of three bands corresponding to the frequencies, $a = 568$, $b = 445$, and $c = 291$ cm.$^{-1}$.

A Photographic Method of Measuring Refractive Indices. By T. M. Lowry, F.R.S. and C. B. Allsopp.

A film of liquid is formed between th half-platinised plates of a quartz etalon The etalon is illuminated with multi chromatic light from a metallic arc, and th interference bands formed in the film ar focussed by an achromatic lens on the sli of a spectrograph. After calibrating th instrument with an air film, the refractiv index of the liquid is deduced from th number of ripples between two fixed point on the slit of the spectrograph.

Infra-Red Investigations of Molecul Structure. By C. P. Snow and E. K Rideal. Communicated by T. M. Lowr F.R.S.

The vibration-rotation band ($n'' = \frac{1}{2} \rightarrow n' = \frac{3}{2}$) of CO has been resolved completel Its centre is at 2144 ± 0.4 cm.$^{-1}$, it has no branch and the separations of lines conver on the side of higher frequency and diver on the lower side. The overtone ($n'' = \frac{1}{2}$— $n' = \frac{5}{2}$) has been plotted, and partially r solved. The general character of vibratio rotation bands carried by ^1S molecules discussed, and the CO bands are shown be consistent with the scheme. The mo cular constants deduced from the vibratio bands are compared with those from t

electronic bands.

From positions of band lines, constants of potential functions have been determined, and the data are found to give excellent concordance when the method first applied by Kratzer is used. Later, constants of general potential functions are included in a theoretical method for determination of ratio intensities of overtone and fundamental.

A Flow Method for Comparing the Specific Heats of Gases. By P. M. S. BLACKETT, P. S. H. HENRY, AND E. K. RIDEAL. Communicated by Sir Ernest Rutherford, P.R.S.

A slow stream of gas passes through a narrow tube, along which a temperature gradient has been established. The temperature of the gas changes as it passes along, so that there is a heat transfer between the gas and the tube, as a result of which the temperature distribution along the tube alters slightly. Under certain conditions, measured temperature change, due to flow, is a direct measure of specific heat of the gas.

An apparatus is described embodying this principle. It consists of an electrically heated iron tube, to which are attached constantan wires, in such a way as to measure temperature difference between two points symmetrically placed on the tube.

Results for measured ratios of specific heats of air, CO_2, H_2 and helium are shown to agree, within experimental error of about 1 in 500, with accepted values.

Papers read in title only :—

On the Temperature Variation of the Specific Heats of Hydrogen and Nitrogen. By J. H. BRINKWORTH. Communicated by H. L. Callendar, F.R.S.

It is shown that the specific heats of nitrogen can be calculated to an accuracy of 1 in 500, over temp. range 60°-1,200° K, provided a suitable form (Callendar's) of characteristic gas equation is used. A modification of the Planck-Einstein formula for rotational specific heat is proposed. It is then shown that calculated values of specific heats of hydrogen agree extremely well with experimental values at temps. below 600° K. At 1,000° K. calculated values are somewhat high, but excellent agreement with some recent measurements is again found at 1,200° to 1,600° K. Values are deduced for moments of inertia of molecules of hydrogen and nitrogen.

The Variation of the Dielectric Constants of Some Organic Liquids with Frequency in the Range 1 to 10 Kilocycles. By R. W. LUNT AND M. A. GOVINDA RAU. Communicated by F. G. Donnan, F.R.S.

The dielectric constant of benzene, ether, methylated ether, chloroform, ethyl alcohol, acetone, aniline and nitrobenzene, and the conductivity of the four last mentioned substances has been determined in the frequency range 1 to 10^3 kc. No variation of the constant has been observed for benzene, ether and chloroform, whilst for the remaining liquids a slight increase takes places in the range 10^2 to 10^3 kc. In this range the conductivity of aniline diminishes rapidly as the frequency is increased, that of nitrobenzene diminishes slightly, whilst that of ethyl alcohol and of acetone does not vary.

The International Temperature Scale between 0° and 100° C. By J. A. HALL. Communicated by Sir Joseph Petavel, F.R.S.

An extensive intercomparison has been made between the platinum-resistance thermometer and a number of mercury in *verre dur* thermometers, standardised by the Bureau International des Poids et Mesures. It is shown that the change from the mercury in *verre dur* thermometer to the platinum thermometer, as the standard of the National Physical Laboratory, will not alter the temperature scale used by that institution by more than 0.002° C. between 0° and 50° C. or 0.005° C. between 50° and 100° C.

The technique of using mercury and platinum thermometers for work of high precision is examined in detail. In case of mercury thermometer numerical data are given regarding certain sources of error (zero depression and recovery, distillation, capillary forces, stem exposure).

The Dissociation of Acids in Methyl and Ethyl Alcohol. By D. M. MURRAY-RUST AND SIR HAROLD HARTLEY, *F.R.S.*

The electrical conductivities of solutions of the following acids in methyl and ethyl alcohols have been measured over a range of concentration from 0.0001 N to 0.002 N : HCl, $HClO_4$, $HClO_3$, $HEtSO_4$, $HSO_3C_6H_5$, HNO_3, $HCNS$, HIO_3. The first five acids are found to be strong electrolytes in both alcohols, while the last three are weak acids. Nitric and thiocyanic acids have dissociation constants in alcohol about same order as that of benzoic acid in water; iodic acid is much weaker. A comparison of slopes of conductivity curves for the strong acids with theoretical slope for a completely dissociated electrolyte, calculated from

Onsager's equation, shows a probably appreciable association of these acids in ethyl alcohol, even in very dilute solution.

From measurements with hydrogen chloride, the mobility of the hydrion is calculated to be 142 in methyl, and 59.5 in ethyl alcohol. Addition of small quantities of water to solutions of acids in alcohol causes large decrease of conductivity of the strong acids and correspondingly large increase in case of weak acids, and can be used as a qualitative test to distinguish between the two classes.

The Influence of Molecular Form and Anisotropy on the Refractivity and Dielectric Behaviour of Liquids. By K. S. Krishnan. Communicated by Sir Venkata Raman, F.R.S.

The theory of the optical and electrical properties of liquids outlined in a paper by Raman and Krishnan is here applied to the case of benzene for which the necessary data are available. The deviations from the Lorentz refraction formula are, according to the theory, the effect jointly of the non-spherical shape of the molecule, which results in the local polarisation field being anisotropic, and of the optical anisotropy of the molecule itself. Data on X-ray diffraction and on light-scattering by benzene liquid give respectively the form and optical anisotropy of the molecule, and furnish the constants appearing in the formulæ. The change in the Lorentz refraction "constant" in passing from vapour to liquid, and the effect of temperature and pressure variations on the same "constant" are successfully evaluated numerically, in satisfactory agreement with experiment. The application of the theory to the dielectric behaviour of liquid benzene is equally successful.

On Thursday, November 21, the Croonian Lecture was delivered by Prof. J. P. Hill, F.R.S., who took as his subject "The Developmental History of the Primates."

SOCIETY OF GLASS TECHNOLOGY.

A Meeting of the Society was held in the Department of Coal Gas and Fuel Industries, The University, Leeds, on November 20.

A general discussion on *The Function of Cullet in Glassmaking* followed the reading of the two following papers :—

The Effect of Repeated Re-Melting of Glass in Sillimanite and in Fireclay Pots. By A. A. Childs, Violet Dimbleby, M.Sc., H. W. Howes, M.Sc.Tech., and Prof. W. E. S. Turner.

The Effect on Some Physical Properties of Glass Repeatedly Melted in Platinum. By Violet Dimbleby, M.Sc., H. W. Howes, M.Sc.Tech., F. Winks, M.Sc.Tech., and Prof. W. E. S. Turner.

The following paper was also received :—

The Influence of Manganese Oxide on Some Properties of Glass. By A. A. Childs, Violet Dimbleby, M.Sc., F. Winks, M.Sc.Tech., and Prof. W. E. S. Turner.

SOCIETY OF PUBLIC ANALYSTS.

November 6.

The following papers were read :—

The Grouping of Fatty Oils with Special Reference to Olive Oil. By E. R. Bolton, F.I.C., and K. A. Williams, B.Sc., A.I.C.

From the examination of a large number of different types of fatty oils the authors have shown that, if the unsaponifiable matter be separated as they describe, and its iodine value determined, the oils are divided into four groups :— Group 1—having iodine value 64 to 70—contains the animal fats and a few vegetable fats (the coconut family); Group 2—having iodine value 90 to 96—contains the fish and marine animal oils and cocoa-butter; Group 3—having iodine value 117 to 124—contains the vegetable oils and fats; Group 4—having iodine value 197 to 206—contains olive oil only. They recommend, for the determination of the iodine value, the pyridine sulphate dibromide method of Rosenmund and Kuhnhenn; the Hübl method, however, may be used, but the Wijs method is not suitable. Olive oil is readily distinguishable from other oils, and adulterants, and may be approximately estimated.

The Heat Resistance Curve: A New Bacteriological Test for Pasteurised Food. By Cuthbert Dukes, M.D., M.Sc., D.P.H.

The idea on which the test is based is that if food has been pasteurised, at say 60° C., then a re-heating of the food to any temperature less than 60° C. will not appreciably reduce the number of bacteria, whereas heating above the pasteurising temperature of 60° C. may cause a considerable reduction in the number of bacteria per grm. or per c.c. This is due to the fact that bacteria living in pasteurised food have already withstood, and can again withstand, a temperature of 60° C. The mixed bacteria population of unpasteurised food, on the other hand, is reduced progressively as the temperature is raised from 50 to 60° C., and onwards. In short, pasteurised food

differs from unpasteurised in that subsequent heating causes a large reduction in the number of bacteria only when temperatures higher than the pasteurising temperature are reached, whereas in unpasteurised food the bacteria are reduced progressively and uninterruptedly as the temperature is raised. When an examination is made of an unpasteurised food plentifully stocked with bacteria, the heat resistance test reveals a great reduction in the number of surviving bacteria as the scale is ascended from 55 to 75° C. When these figures are plotted out as a graph, a characteristic steep curve is obtained. This steep decline is the normal response of unheated food to the heat resistance test. When the test is applied to, say, a pasteurised Cheddar cheese, the graph of the figures obtained expresses itself in a horizontal line. The test is therefore, of value in determining whether food has been pasteurised, and, if so, the approximate temperature of pasteurisation.

A New Borax Solubility Test for Lactic Acid or Natural Sour Casein. By W. R. Mummery, F.I.C., and F. Bishop

The three methods hitherto mainly used are considered unsuitable for the classification of commercial casein, since they do not afford sufficient information as to the degree of solubility, and the conditions of determination are not sufficiently defined. A new method has been based on the fact that 12.5 grms. of borax in water are required to dissolve 100 grms. of good commercial casein to obtain a solution which, when diluted, had a constant P_H value. This value is termined the "solubility index," and affords a means of classifying caseins.

MINERALOGICAL SOCIETY.

Anniversary Meeting, November 6,

Dr. G. T. Prior in the chair. The following papers were read :—

On Scawtite, a New Mineral from Scawt Hill, Co. Antrim (with chemical analysis by Mr. M. H. Hey). By Dr. C. E. Tilley.

This new monoclinic mineral, with composition $6CaO.4SiO_2.3CO_2$, occurs in the contact zone between the chalk and tertiary dolerite, from which another new mineral, larnite, was recently described (*Min. Mag*, vol. xxii, p. 77).

On the Composition-Plane of 010-twins in the Acid Plagioclases. By Dr. F. Coles Phillips.

In the true pericline twin, the inclination of the variable composition-plane for different composition is correctly given by Wulfing's curve. T. Barth's conclusion that there is no regular variation is not justifiable, and results partly from confusion with other twin laws such as that of acline A. The pericline twin should be of frequent occurrence in the crystalline schists.

On the Variation of Optical Properties with Chemical Composition in the Rhodonite-Bustamite Series. By M. H. Hey.

A complete optical study of three analysed members of the Rhodonite-Bustamite series, together with the data available from the literature, shows regular variation in the optical properties and specific gravity with change in lime content.

A Preliminary Account of Some Mineralogical and Chemical Changes induced by Progressive Metamorphism in the Green Bed Group of the Scottish Dalradian. By Dr. F. Coles Phillips.

Analyses prove the Green Beds to be a truly isochemical series in respect of the constituents significant in progressive metamorphism. The earliest-formed plagioclase is pure albite, but a progressive entry of the anorthite molecule can be traced. The adjustment to equilibrium is apparently close, all the reconstituted plagioclase of a given rock having the same composition. In the highest grades the felspar is a medium andesine. Similar variations with increasing grade are found in the associated epidiorites. The earliest-formed greenish micaceous mineral is shown to be a true potash mica, which undergoes increase in FeO in higher grades. Hornblende appears in the chlorite zone only in rocks low in potash.

At the Anniversary Meeting on November 5, the following were elected officers and members of Council :—

President, Dr. G. T. Prior; *Vice-Presidents*, Sir J. S. Flett, Dr. G. F. Herbert Smith; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith; *Foreign Secretary*, Dr. J. W. Evans; *Editor of the Journal*, Dr. L. J. Spencer; *Ordinary Members of Council*, Mr. A. J. Bull, Prof. C. G. Cullis, Prof. H. Hilton, Dr. W. F. P. McLintock, Col. N. T. Belaiew, Mr. Harvey Collingridge, Mr. Henry Dewey, Prof. Arthur Holmes, Dr. A. Brammall, Mr. G. McDonald Davies, Prof. W. G. Fearnsides, Miss M. W. Porter.

ROYAL AGRICULTURAL SOCIETY.

At the monthly Council meeting on November 6, Mr. H. Dent Brocklehurst (Chairman) reported that the list of samples analysed for members by the Consulting Chemist during the months of August, Sep-

tember and October had been submitted to the Committee. Dr. Voelcker had read to the Committee a copy of the letter which he had written to the *Farmer and Stockbreeder* setting out the facts of a case regarding the sale of barley meal which had recently been before the Courts. An interview had been arranged between Dr. Addison, Parliamentary Secretary to the Ministry of Agriculture, Mr. H. Dent Brocklehurst, Chairman of the Chemical Committee, Mr. Fred Smith and Dr. Voelcker to discuss the question of the use of foreign barley of inferior quality.

PROGRESS IN ELECTRICAL SCIENCE AND INDUSTRY.

Mr. Llewelyn B. Atkinson, M.I.E.E., delivered his inaugural address as chairman of the Council of the Royal Society of Arts on "Fifty Years of Electrical Science and Industry."

He referred to the practically simultaneous invention by Varley, Wheatstone, and Siemens of the dynamo, which marked the birth of the modern electric age, 62 years ago, within his own lifetime, and recalled that the earliest electric light in London streets was outside the old Gaiety Theatre, in 1878. Tracing the progress of the science, he dealt with the developments of dynamo electric machinery, and indicated developments in the distribution of electricity by cables. It was well known, he said, that in other countries, both in America and on the Continent, all the earlier developments were made by overhead wires, but in this country there had always been the strongest objection to these. With regard to the great increase of the use of electricity industrially after the War, due to the great increase in the price of coal, he said he had long preached that the one thing necessary for increasing the uses of electricity was a high price of coal, due to the fact that in isolated power plants coal was the heaviest item of cost; in electrical production and distribution it was secondary.

Speaking of the application of electricity to telegraphy, telephony, and to wireless communication, he said the first telephone he ever heard was a pair of magneto instruments made in 1876 by the father of one of his schoolfellows, and he himself gave a lecture at school on the telephone in 1881. It was very remarkable that, except in detail, the original carbon microphone transmitter and the permanent magnet and coil receiver had not been altered. Telephone subscribers over the whole world now were —or in a few months would be—in touch telephonically with one another, a result very largely due to British skill and initiative. This country, however, stood badly in the matter of number of telephones per head of the population, and in some quarters it was considered that this would not be overcome until the telephone service became an independent unit, managed on purely commercial lines, without the implications involved in its finances being conditioned by Treasury requirements or necessities, or its *personnel* being Civil Service officials.

Approximately over the last 25 years the consumption of electricity produced by supply authorities had doubled every six years. The rate, if anything, was increasing, and they knew from the experience of other countries that the point of saturation was a good way off. The electrification of main-line railways had not yet commenced. They might look forward, say, for 20 years to a period of great activity, both in the science and in the industrials applications of electricity.

NOTICES OF BOOKS.

(1) *Die Oele und Fette im Der Textilindustrie*. By PROF. W. HERBIG. Second, enlarged edition. Pp. 451, with 39 illustrations. Price (bound) 32 marks.

(2) *Die Kakaobutter und ihre Verfalschungen*. By DR. H. FINKE. Pp. 240, with two plates. Price 20 marks.

Both published by Wissenschaftliche Verlagsgesellschaft m.b.H., Stuttgart. 1929.

These noteworthy technological works form volumes iii and xii respectively in a series of Monographs on the Chemistry of Fats, edited by Prof. K. H. Bauer.

(1) There have been so many important developments in relation to the Fats known to the textile industry in the course of the last few years that in meeting the demand for a new edition of the late Prof. Herbig's work it has been necessary to increase its bulk by half. Important advances have taken place in the methods of decomposition, extraction, application and evaluation of all fats known to textile chemists. These have received due attention in the volume under review. Of interest, too, is the section dealing with the numerous trade preparations (often with fantastic names) of which the author is very critical.

The author was a recognised authority in this field and the present work may be considered as the result of his long acquaintance with the particular branch of applied chemistry on which he wrote.

(2) The second book is written by the

best known of continental chocolate and confectionery manufacturers. He has made a special study of Cocoa-butter and its uses. As its price rose there was an incentive to adulterate it with cheaper products. Its removal from cocoa products has led to a search for uses and it now finds extensive employment in many cream preparations. Dr. Fincke's account of it will be read with interest by analytical and food chemists.

Both volumes are worthy of the attention of chemists in this country.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.

Monday, November 25, at 8 p.m.—(Cantor Lecture.) E. G. Richardson, B. A., Ph.D., D.Sc. : "Musical and Scientific Aspects of Wind Instruments." (Lecture II.)

Wednesday, November 27, at 8 p.m.—(Dr. Mann Lecture.) C. Norman Kemp, B.Sc., A.I.C., Secretary, Scottish Royal Society of Trts, "The Examination of Coal and Coke by X-rays." Dr. Frank S. Sinnatt, F.I.C., M.I.Min.E., will preside.

UNIVERSITY COLLEGE, LONDON.

Monday, November 25, at 2 p.m.—"Medicine in the Days of Shakespeare." A public lecture by Prof. Herbert Spencer, F.R.C.P., Fellow of the College.

INSTITUTE OF CHEMISTRY.

Belfast and District Section.

Generally the Meetings will be held in the Physics Lecture Theatre of the Royal Belfast Academical Institution, and will commence at 7.30 p.m. Otherwise members will be specially notified.

Thursday, November 28. — Annual Dinner.

Friday, November 29, at 5 p.m.—"The Professional Aspects of a Career in Chemistry." By R. L. Collett. (In the Chemistry Department, Queen's University.)

THE PHYSICAL SOCIETY.

A meeting will be held at 5 p.m., on November 22, at the Imperial College of Science, South Kensington. The following papers will be read :—

"Heaviside's Operational Method." By D. P. Dalzell.

"The Dynamical Theory of Resonators." By E. T. Hanson, B.A.

"Escapement Errors of Pendulum Clock." By E. C. Atkinson, M.A.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

32,486.—Bataafsche Petroleum Maatschappij.—Manufacture of ammonium sulphate. October 25.

32,487.—Bataafsche Petioleum Matschappij.—Manufacture of aqueous dispersions of bitumen. October 25.

31,967.—Bataafsche Petroleum Maatschappij.—Admixing aqueous dispersions etc. October 21.

31,948.—British and Dominions Feralloy, Ltd.—Catalytic treatment of organic substances. October 21.

32,085.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of therapeutically-valuable substances. October 22.

Specifications Published.

292,951.—Du Pont De Nemours & Co., E. I. Process for the high concentration of nitric acid.

298,972.—Hercules Powder Co.—Production of alkyl esters of resin acids.

320,606.—British Celanese, Ltd., and Billing, J.—Concentration of lower aliphatic acids.

294,986.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of acid wood dyestuffs.

320,742.—British Dyestuffs Corporation, Ltd., and Hailwood, A. J.—Manufacture of solubilised vat-dye and process for dyeing therewith.

Abstract Published.

318,582.—Amino-acids. — Hoffman - La Roche & Co., Akt.- Ges., F., 184, Grenzacher Street, Basle, Switzerland.

β-Aryl-α-aminopropionic acids and their substitution products are prepared by heating the corresponding α-lactones (lactimides) with hydriodic acid, to which acetic anhydride and red phosphorus may be added if desired. According to the examples : (1) phenylalanine is obtained by heating with hydriodic acid the azlactone resulting from the condensation of benzaldehyde with hip-

puric acid; (2) β-[3 : 5-diiodo-4-(4^1-oxyphenoxy)-phenyl]-α-aminopropionic acid is prepared by heating 4-[3^1 : 5^1-diiodo-4^1-(4^{11} - methoxyphenoxy) - benzylidene] - 2 - phenyl-5-oxazolone with hydriodic acid, *acetic anhydride* and *red phosphorus*; the product may be converted by iodination into thyroxine.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

505,380.—Illustration of a Grecian mythical figure of a winged lion, human female head and a pestle of mortar and the word KOSMOS.—Chemical substances used in photography, and photographic plates and photographic films (sensitized).—Kosmos Photographics, Limited, Balfour House, Finsbury Pavement, London, E.C.2., and Pixmore Avenue, Letchworth, Hertfordshire. October 30.

IGEFA.

505,980.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Bayer Products, Limited, 31 to 34, Basinghall Street, London, E.C.2. Oct.

KALSOGEN.

506,073.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives. — Florence Elizabeth Gregory, 26, Colson Road, East Croydon, Surrey. October 30th.

OPALOGEN.

506,639.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives.—I. G. Farbenindustrie Akitengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. October 30.

AZETOPAL.

506,640.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives.—I. G. Farbenindustrie Aktiengesellschaft. Mainzerland-

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DICTIONARY OF EDUCATIONISTS.

By REV. J. E. ROSCOE, M.A.
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This is an interesting and useful Work, giving in tabloid form Biographical Sketches of Prominent Educationists from the earliest times and in all countries. Mr. Roscoe has written many important books, but none of greater importance in its own sphere than the above Work,

SHIFT TOWARDS THE RED OF SPECTRAL LINES FROM RADIATION PASSING THROUGH GREAT DEPTHS OF INTERSTELLAR SPACE.

By F. H. LORING.

Professor F. Zwicky in the October issue of the *Proceedings of the National Academy of Sciences, of U.S.A.*, discusses the new problem known as the *redshift* of the spectral lines of very distant nebulæ. It has a profound bearing on the newer ideas concerning the greater universe especially in the light of the theory of relativity and of other matters.

It appears that E. Hubble (*Proc. Nat. Acad. Sci., U.S.A.*, 1929, 15, 168) finds that the *apparent* velocity of recession, as the redshift would *apparently* indicate, is a linear quantity corresponding to 500 kilometres per 10^6 parsecs. Large variations, however, are found for the nearest nebulæ which may be ascribed to their various translatory motions, or to their *peculiar* motions, to use Zwicky's words here. Very recent observations by M. Humason (private information given to Prof. Zwicky) "seem to indicate that for very large distances (50×10^6 light years) the individual deviations become so great (3000km./sec. out of 8000 km./sec.) they hardly can be due to peculiar motions and must, therefore, be accounted for in some other way."

Continuing these observations, as set out in Zwicky's paper: "The relative shift of frequency $\Delta\nu/\nu$ representing the velocity of recession is apparently independent of the frequency. The available range in the spectrum is, however, not very large. Some exceptions have been found suggesting that $\Delta\nu/\nu$ for $H\beta$ is somewhat greater than for $H\gamma$."

The above shift is not related to absorption or scattering of light to any appreciable extent.

The optical images of extragalactic nebulæ are well defined, the only factor from this point of view being distance.

The spectral absorption lines from these nebulæ are not very well defined, "but no systematic investigation of their shape has been carried out." M. Humason's recent observations show that the width of the lines from Andromeda nebulæ M_{32} and M_{31} are between 4A and 7A, this being the range.

Referring to Hubble's relation "to objects in our own galactic system, the velocity of recession," by extrapolation, "would become so small (5 km./sec. for 10,000 parsecs) that it would escape observation. The theoretical considerations proposed by the

author [Zwicky] in the following made it probable that an appreciable effect should also be observed in our galaxy. This suggestion was tested by Dr. ten Bruggencate, *whose work will be published shortly.* His essential result is that the velocity of recession of the globular clusters is a function of the galactic latitude, increasing with decreasing latatude. A paper by E. von der Pahlen and E. Freundlich in the *Publikationen des Astrophysikalischen Observatoriums zu Potsdam, 86*, Bd.26, Heft 3, should be mentioned in this connection. Fig. 6 on *page 44 of this paper shows a correlation* between the radial velocity of globular clusters and the galactic latitude. The authors, however, interpret it as being due to real motions."

Prof. Zwicky, in discussing the theoretical possibilities of accounting for the phenomenon described above, in effect says :—

According to de Sitter's Universe and proposed by de Sitter this would be such as to account for a velocity of recession of the far-distant nebulæ, but Hubble's linear relation (see above) involves " additional assumptions about the distribution of the nebulæ." See R. C. Tolman's paper (*Astrophys. Journ.*, 1929, *49*, 245) for detailed information. It appears that de Sitter's explanation when applied to our galactic system, especially in the light of Dr. ten Bruggencate's findings, is unsatisfactory as a theory based *only* on geometry.

The Compton-Doppler effect on free electrons is next considered. It is known that interstellar space contains " gaseous masses distributed " *in a very dilute state*, the steady Ca+ and Na absorption lines providing good proof of this. Ions thus are present, and nebular light might suffer a Compton shift due to free electrons; but, passing over some wave-length difference considerations, " the light scattered in all directions would make the interstellar space intolerably opaque which disposes of the *above explanation.*" *In the case under consideration*, very high-speed electrons may exist, which is suggested by the existence of cosmic radiation. " In this case, an appreciable shift of frequency may be produced by one collision." Scattered light of considerable amount would seem to follow, so that there is a difficulty in applying this theory, though satisfactory up to a point. Moreover, the " Compton effect or the Raman effect, etc., will be in a hopeless position regarding the good definition of the images," as mentioned above.

Passing to the next consideration, from the usual gravitational shift of spectral lines (Einstein) " one might expect a shift of spectral lines due to the difference of the static gravitational potential at different distances from the centre of a galaxy. This effect, of course, has no relation to the distance of the observed galaxy from our own *system and, therefore, cannot provide any* explanation of the phenomenon discussed in this paper." It might, however, " have some bearing on the width of the observed spectral lines, as light coming from different points of the distant galaxy will show varying shifts . . . This effect might cause a violet shift of the light travelling from the outer regions of our galaxy toward the centre."

Coming now to the crux of Zwicky's interesting paper, the gravitational drag of light has to be considered. According to the theory of relativity, " a light quantum $h\nu$ has an inertial and gravitational mass $h\nu/c^2$. It should be expected, therefore, that a *quantum $h\nu$ passing a mass M will not only* be deflected but it will also transfer momentum and energy to the mass M and make it recoil. During this process, the light quantum will change its energy and, therefore, its frequency." This is a gravitational analogue of the Compton effect and is susceptible to rough calculations, the results of which seem to fit in with the observed red-*shift when taking into theoretical account* the factors necessary.

Zwicky's paper must be referred to for the mathematical procedure. Suggestions of experimental tests are put forward and the author even proposes that " it might be interesting to study the gravitational drag exerted by light upon light."

FEDERATION OF BRITISH INDUSTRIES.

THE NEXT IMPERIAL CONFERENCE.

In view of the forthcoming Imperial Conference in 1930, an arrangement has been come to between the Association of British Chambers of Commerce, the Federation of British Industries and the Chamber of Shipping of the United Kingdom, representing the commercial, industrial and shipping interests of this country, to form a British Preparatory Committee to consider the general question of Empire Commercial Policy, with the object of co-ordinating as far as possible the views of the business community of the United Kingdom and of presenting to His Majesty's Government joint recommendations on all questions upon which unanimity of opinion can be obtained.

MATTER AND LOGIC.

By Dr. W. Tombrock.

The Proton as a complex material unit in a cyclonic state of motion, the electron as a larger simple material particle, the mechanical atom.

The solutions provided by logic bear the character of simplicity . . . *simplicitas veri sigillum.*

Perhaps some of the older of you still remember Davy's *perpetuum mobile?* The name of a Frenchman, Gauguin or Gaugain, I do not remember the correct spelling, was also connected with this question, a singular scientific puzzle of the time. In order not to be too specialised, I will only in a few lines sketch for you the primitive form of the case: Given a *certain* electromotive arrangement, a practical scheme by means of which electromotive force is produced, then a *perpetuum mobile had* to be possible. You can understand that some argument was involved before you came to this final conclusion: theoretical *perpetuum* mobile. Naturally everyone was convinced of the impossibility of this *perpetuum mobile* and yet it appeared no other than that this *had* to exist. I believe that this case with such a solution did not then appear for the first time, in any case the first intellects in science must have given their attention to it; but it remained, a contradiction to a generally acknowledged law of empirical experience.

Logic now provided a solution to this almost directly.

The argument which led to it was this: Nature knows no contradictions—I assume the fundamental law to be correct—thus there *must* be an error in this problem, which leads to a contradiction to the abovementioned fundamental law. This error can lie either in the deduction which leads to that conclusion, or in the starting-point, in the first assumptions.

That the error might lie in the deduction was not probable this time, because one of the many scientific leaders, who have occupied themselves with the case, would have been sure to have detected it. There thus remained the probability that the error lay in the first assumptions.

Among these was that a given difference of potential should remain constant . . . This had to be assumed by the savants and was probably incorrect. It could be shown directly that this solution was the correct one, the difference of potential was indeed found not to be constant.

From which you can see how simply logic can lead to a solution . . . *simple comme bonjour.*

I have related to you this history from personal experience because in our discussions in the *Chemical News*, 1928 and 1929, we again arrived at a very simple solution and indeed this :—

Our present-day knowledge of nature can, physically and chemically, be fundamentally explained by the motions of particles which cannot simultaneously occupy the same place and among which protons function as complex material units in a cyclonic state of motion, while electrons appear as larger simple particles.

This solution was obtained on the basis of purely logical considerations with regard to various data from our present natural knowledge.

It is *not* my intention to write here about the general first principles and the *general purpose* and the final conclusion to which we have been brought by the logically thought out development. I shall do that in an article to follow . . . but it is my plan to show, on the basis of certain references from the literature, how this conclusion gradually came into being from still simpler and less coherent ideas and also, likewise from a few quotations from the work of prominent physicists, in how far our abovementioned conclusion is confirmed thereby.

In this I shall for the rest be brief.

The quotations from my own publications will then follow afterwards.

Sir J. J. Thomson writes in *Nature*, September 4, 1926, *The Mechanics of the Electric Field* "—as follows :— P. 342: "Let us consider some of the consequences of supposing that electric force consists of impulses separated by finite times. I must point out that this conception involves the existence in the universe of a structure beyond that represented by electrons and positive particles; if there were no structure of this kind, we could not account for the intervals which elapse between the impulses. This structure must be far finer in texture than the electrons; thus on this view, the electron does not represent the last word in minuteness and there are still smaller entities awaiting discovery by the physicists.

. . ., we may liken it to a sub-atomic and sub-electronic gas the particles of which are much finer than the electrons.

To distinguish between the positive and negative charges, we may suppose that the particles rotate round the charges and that the rotation as viewed from the centre is in

one direction for the positive and in the opposite direction for the negative charge . .

P. 345. Thus the intermittance of electrical force demands a corpuscular theory of light, *i.e.*, a theory where energy is done up in bundles which do not alter in size as they travel through space.

If we compare the atom with its electrons to a solar system, we may compare an electron or a positive particle to the centre of a nebula and regard the electron as surrounded by an atmosphere of small particles."

G. P. Thomson writes in *Scientia* (Milan) 1, ix, '29, "*Waves or Particles?*" p. 169: "Another point of view tends to consider the waves as having only a mathematical existence, a kind of ghost of a wave existing only as a name to describe the complex laws by which we must suppose the particles to be guided."

The last quotation gives the same idea as that which we have repeatedly expressed in our discussions: light is primarily emission of electrons, larger simple material particles, which by their motion through the (smaller) ether-particles cause therein by a secondary process disturbances which produce effects which are best to be elucidated by means of an undulation theory.

In the first quotation from Sir J. J. Thomson we find: particles, smaller than protons and electrons, which resemble a gas, complex swarms, consisting of many particles around protons and electrons, and rotations in opposite senses for the explanation of positive and negative electricity.

Let us now compare with this what we wrote in 1925. "*Stof*"-*een orientatie-poging van een chemicus.* (P. Harte, Bergen op Zoom.)

P. 26 Under "*Meer physische eigenschappen en verschynselen*" . . . "Kan dit met zwaarte samenhangen? Twee stoffelyke voorwerpen zuigen, als het ware, ether uit hun tusschenruimte weg? Uit de zoo ontstaande etherverdunning volgt een etherdruk, die de lichamen naar elkaar toedryft? . . . Wat wy met aantrekking betitelen?

P. 27. Als het voorgaande juist is, volgt dan niet, dat de *massa* der lichamen niet tout court, met de *totale hoeveelheid materie-deeltjes*, electronen (en protonen), mag evenredig gesteld worden, maar dat men er dan ook, en wel byzonder, op letten moet, *welke bewegingsconfiguraties de uiteindelyke stofdeeltjes samenstellen* . . .

Hangt dit samen met *negatieve en positieve electriciteit* . . ., min of meer periodieke, *cyclonische* bewegingen dringen zich hieby sterk aan ons voorstellingsvermogen op."

[P. 26. Under "*Further Physical Properties and Phenomena*" . . . "Can this be connected with *gravitation*? Two material objects, as it were, suck the ether from out the space between them? An ether-pressure which drives the bodies towards one another, follows from the so-produced ether rarifaction? . . . to which we give the name attraction?

P. 27. If what proceeds is correct, then there follows as a consequence of it that the *mass* of the bodies may *no longer* be tout court taken as proportional to the *total quantity of material-particles*, electrons (and protons), but that one must then also and indeed particularly take into account *what configurations of motion are formed by the outermost material particles* . . .

Is this connected with *negative and positive electricity*? . . . more or less periodic *cyclonic* motions thrust themselves upon our imaginative faculty in this connection."]

You see here in 1925, thus before the article by Sir J. J. Thomson came into my possession, there were an explanation of gravitation, an ether resembling a gas, and the concept of cyclonic motions present in an embryonic form in my writings.

I did not then think of complex protons. Indeed Sir J. J. Thomson thought of complexity of the proton in quite a different way than I did (afterwards), when he writes "that the particles rotate *round the charges*." The complex proton, as I now conceive it, is simply an ether cyclone, a complex material unit with a cyclonic form of motion, with regard to which form of motion I was thinking of whirl pools in water, or of the violent cyclonic whirl-winds in our atmosphere which can destroy a town with as much ease as can modern artillery. But this complex proton is an ether-whirl, nothing more or less, and it fits excellently in this form, as we saw, over and against and beside the conception of the electron as a larger simple material particle, larger than the particles which constitute the proton.

There is thus much that is analogous in the two ideas, and this artice by Sir J. J. Thomson was undoubtedly a support for my views, but a large and characteristic difference is, however, also to be noticed.

In June, 1926, I wrote in "*Miller's Experiments and the Constitution of Matter*" (Harte, Bergen op Zoom, Holland), p. 20: "Protons, I imagine, are larger material particles which rotate strongly but have little translational motion. They are irregu-

lar in shape and cause a kind of cyclonic motion in the surrounding ether-particles.

Electrons, I assume, possess both a rotation and a more or less considerable translational motion. They are also centres of motion among the surrounding ether-particles."

In this form the agreement with Sir J. J. Thomson's picture is indeed very pronounced!

In "*Atomic Electricity Explained and Explained Away*," of my composition and published in *The Chemical News*, March 30, 1928, this picture is still practically unaltered, an explanation of gravitation and of the dualistic character of light was alluded to.

It was first in "*The Connection between Proton and Cosmic (Millikan) Rays*," (*Chem. News*, Sept. 30, 1929), that I arrived at the assumption of a complex proton which with its sharply drawn mechanical presentation also brought much elucidation and strengthening of other points.

I have *nowhere* read of an actual ultimate structure of the proton; even Sir J. J. Thomson, at any rate in the article in *Nature* (Sept., 1926) has nothing to say on the matter. To him the proton remains a charge, around which the (ether-) particles rotate, what a *charge* itself is mechanically, he does *not* say.

In my writings there is *no longer any* charge, or, if you would prefer to look at it another way, the "charge" is simply the cyclonic form of motion of the constituent particles of the proton, which form of motion, however, serves at the same time for the explanation of gravitation.

In my writings I consider this to be characteristic: proton, electron and ether are perfectly understandable. Logic indeed first demands: "an explanation must be understandable." Also the ether as we conceive it, . . . it is no longer continuous, no longer immaterial, but material just as a gas is material, as material as everything which can be called matter and it is perfectly understandable, as understandable as a gas, actually, in a certain sense, more understandable because in our ether the constituent particles are simple and more elementary than the more complex gas molecules with the consequences of that complexity.

We look upon protons as primary entities. The atoms as proton-mills which take up and emit electrons and (smaller) ordinary ether-particles. The emitted electrons cause the phenomena of light as heavier rotating projectiles which produce a strong, secondary disturbance in the ether.

Protons are the real constituents of the atom. This is an old chemical idea and therefore I permit myself to call the above-described atom model . . . chemical, the chemical mechanism of the atom, in brief: *the mechanical atom.*

November, 1929.
Bergen op Zoom,
Holland.

NATURAL WATERS AND BREWING.

Bulletin No. 17, published October 28, 1929, from the Bureau of Bio-Technology by Messrs. Murphy & Son., Wheathampstead, Herts, contains one paper (22 pp.) entitled "The Adjustment of Natural Waters for Brewing Purposes." The early observations and comments upon the nature of the waters preferred for brewing are traced and explained, particularly in the light of modern views and practice in connection with the control of the hydrogen ion concentration and de-carbonisation.

The writers (A. J. Murphy and F. A. Mason) recommend the use of lactic acid to reduce alkalinity in preference to other (mineral) acids since the neutral lactates of calcium magnesium and sodium so produced, impart a "fullness" to the beer. An instance is given of a water so treated containing

$CaSO_4$	... 17.05	grains per gallon
Ca lactate ...	9.6	,, ,, ,,
Mg lactate ...	35.1	,, ,, ,,

whereas when neutralised with sulphuric acid water of the same origin contained

$CaSO_4$	... 23.0	grains per gallon
$MgSO_4$	... 20.85	,, ,, ,,

Products brewed from waters adjusted by lactic acid treatment have been prominent among those receiving exhibition awards in recent years.

CHEMISTRY AT THE WORLD'S FAIR.

The close connection of chemistry with the necessities and luxuries of modern life and the steady progress which the British Chemical Industry is making, on both scientific and utilitarian lines, will be demonstrated in the British Industries Fair, Olympia, London, from February 17th to 28th, when the exhibit held under the auspices of the Association of British Chemical Manufacturers will be on the ground floor in the annex of the Main Hall.

The exhibit will cover all branches of the industry, including heavy chemicals, fertilisers, explosives, coal tar derivatives, fine chemicals of all kinds

GENERAL NOTES.

RESURRECTION IN TERMS OF CHEMISTRY.

Mr. Henry Alfred Wadworth, of Hereford, who died in August last, aged 77 years, left a remarkable expression of *belief on the Resurrection of the Dead in* his will, which was as follows :—

" At death my body shall be placed in the cheapest decent receptacle and taken in my own trailer and car to the most convenient crematorium and cremated. . . . . .

" I believe (and some of the leading scientific men of the day assure me that I believe rightly) that at my death the organic constituents of my body will be *quickly converted into carbonic acid* and ammonia, and that these gases will by the law of diffusion be at once distributed over the whole world, and will help to build other plants, and in their turn animals, so that in the future every plant and animal in the world will contain an infinitesimal portion of my body.

" The inorganic parts of my body, the phosphates of lime, etc., will also be dissolved, and hy the agency of rains, rivers, *and ocean currents will also* be distributed, but more slowly. The energy left in my body at death, degraded to heat, will quickly leave it and form part of the energy of the universe. This I believe to be true Resurrection of the Dead and the Life Everlasting.

" I believe in God, but, like the GOD of St. Paul's Greeks, it is an unknown GOD, as in our present state of development we are incapable of understanding Him, *His Origin, and some of His laws.*"

RADIUM AND SURGERY.

The Radium Commission says that the relative value of radium therapy in the treatment of cancer, as compared with surgical excision, is a difficult point to assess, for the reason that sufficient facts are not yet available. In the first place most of the available data concern cancer *only in the regions* of the body above mentioned, and, secondly, we have not yet a sufficient number of cases, nor has sufficient time elapsed, to enable us to prepare statistics which will show a true and complete picture. One great point in favour of radium is that its use does not involve the risks and suffering associated *with extensive and mutilating operations*, which are so distressing to all concerned. The operation of introducing radium is in itself a comparatively slight one, and, while the radium is in position, the patient suffers little, if any, discomfort. Under these conditions, and with good prospects of cure without mutilation, patients should be far more ready to consult their doctors, instead of concealing or disregarding their symptoms till it is too late for any form *of effective treatment.*

It is perhaps desirable at this point to deal with two prevalent misconceptions. First, there is no proof whatever that cancer is either infectious or contagious. Secondly, there is no evidence that cancer is hereditary, except in one rare form of cancer of the eye. These fears, therefore, can both be dismissed.

READING UNIVERSITY EXTENSION SCHEME.

An effort is being made to raise a fund of £200,000 for the extension of the *University of* Reading. The attached letter of appeal has been sent to us :—

" We venture to seek your help in the effort now being made to gain support for the University of Reading. The University has outgrown its buildings devoted to teaching and research, and is faced by the problem of raising funds wherewith to extend them.

" The University, constituted by Royal Charter in 1926, is one of the youngest in the British Empire. It is, however, distinguished for the thoroughness with *which it has incorporated into its system* the principle of collegiate residence previously associated more especially with Oxford, Cambridge, and Durham. Students, both men and women, who come to it in large numbers from all parts of the country, enjoy the advantages of corporate life in halls of residence, of which there are six, all controlled by the University Council. The academic activities of the University are conducted *through its Faculties of Letters, Science,* and Agriculture and Horticulture, and through Schools of Fine Art, Music, and Domestic Subjects. More than 400 students are pursuing degree courses, and a still larger number attend the University for other purposes. In agriculture,

horticulture, and dairying the University is a principal national centre for teaching and research, and the reputation of its departments in arts and pure science is deservedly high.

"The University has behind it a striking record of progress. By the sustained efforts of its leaders and supporters, and the munificence of local benefactors, it has been able to equip itself with extensive buildings and lands, and with large endowments for University teaching and research; and also to develop a character of its own as a centre of liberal education under the conditions of a healthy and happy corporate life. If, however, the development of the University is not to be seriously checked, and its promising outlook overcast, it must now enlarge its buildings.

"The full scheme of extension required is estimated to cost £200,000. Towards this total, donations amounting to more than £30,000 have already been made or promised. The local support which the University has received in the past is being maintained; but in view of the University's remarkable record in respect of local benefactions and of its service, not merely to Reading and the South of England but to the whole country, we feel that we are justified in appealing to a wider public. What is at stake is the whole future of an institution which, youthful though it be, has already proved its mettle, won distinction in the field of university education, and trained great numbers of young men and women, coming to it from every part of the kingdom and from overseas, to do honourable service here at home and in the Empire at large.

"The Secretary of the Appeal Fund, the University, Reading, will gladly supply any information with regard to the proposal scheme of extension."

NATIONAL MARK SCHEME FOR MALT FLOUR AND EXTRACT.

The Ministry of Agriculture and Fisheries has just issued a memorandum leaflet (No. 14) on the grading and marking of all-British malt flour and malt extract. The scheme is intended to stimulate the demand for malt products made from home-grown grain.

SMOKELESS FUEL FOR WHITEHALL.

"It is my aim to see that all Government Offices set an example to the nation in smoke abatement, and as soon as it is a practicable proposition every office in Whitehall will be burning nothing but smokeless fuel," stated Mr. George Lansbury, First Commissioner of Works, on November 8, when attending a smoke abatement demonstration at 28, Grosvenor Place, London.

Mr. Lansbury said that the scientific use of coal was an essential condition of the permanent prosperity of the coal industry. It was a great advance to get a smokeless fuel for the domestic grate, all the more so when, in place of the smoke it was possible to obtain oils and spirits which would replace the present supplies from abroad. From the point of view of increased employment it had to be considered whether the development of the low temperature carbonisation process could be made to help the coal industry and at the same time provide a new outlet for labour at the works.

Lt.-Col. W. A. Bristow, Managing Director of Low Temperature Carbonisation, Ltd., stated that a new plant was now being put down at Killingholme on the Humber, and that arrangements had been made to pump the oil from British coal direct to the Admiralty tanks on an adjoining site. Thus for the first time the British Navy would be taking a portion of its oil supplies from home sources.

"In my own office in Whitehall I always have a brightly glowing fire in which nothing but coalite is burned," said Mr. Lansbury, after inspecting various types of grates in which solid smokeless fuels were being burned. He was especially interested in a meal which had been prepared on a coalite kitchen fire; and displayed his knowledge of cookery by testing a joint of beef to see whether it was done to his satisfaction.

NAPHTHOL A.S. DYES ON VISCOSE.

Naphthol A.S. dyes are meeting with increasing application on account of their fastness. They have long been used on cotton fabrics, but it is only recently that the Brenthols have been used for Rayon (or artificial silk) on account of the substantivity of these dyes is given in *Rayon Record* (November 15th).

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, November 21.

THE CROONIAN LECTURE,
ON
THE DEVELOPMENTAL HISTORY OF THE PRIMATES,
Was delivered by
Prof. J. P. HILL, F.R.S.

Starting with the relatively simple developmental conditions met with in the Lemuroidea, the attempt is made to show how much more specialised and cænogenetically modified developmental relations found in the higher Primates may be supposed to have arisen as the result of continued adaptive specialisation, involving more especially acceleration and abbreviation in the developmental processes. A broad survey of the early development and placentation in representatives of the chief sub-divisions of the Order has led to the recognition of four main stages in its evolutionary history, viz., a Lemuroid, a Tarsioid, a Pithecoid, and an Anthropoid developmental stage.

Lemuroid Stage.—The existing Lemurs are regarded, from the developmental point of view, as the remnant of that basal Lemurine stock from which the higher Primates took their origin. In their development they exhibit a combination of primitive features with others which are certainly advanced and which foreshadow conditions characteristic of the higher types. Primitive features are evinced in the constitution of the blastocyst and its central type of development, in the disappearance of the covering trophoblast and consequent exposure of the embryonal ectoderm, in the origin and mode of spreading of the mesoderm, in the formation of the amnion by folds and in the development of the allantois as a free vesicle; while amongst the advanced features may be included the relatively early establishment of a complete chorion and its direct and complete vascularisation by the ingrowth into it of the allantoic vessels and the reduction of the yolk-sac and its vessels. Their placentation is regarded as genuinely primitive and the attempt is made to show how the more specialised hæmochorial type of the higher Primates may have been substituted for it.

Tarsioid Stage.—In this stage, as exemplified by the existing Tarsius, we observe :—

(1) The retention of certain lowly features characteristic of the Lemuroids, *e.g.*, the exposure of the embryonal ectoderm and the development of the amnion by fold-formation.

(2) The realisation of certain developmental tendencies already foreshadowed in them, *e.g.*, the still more precocious differentiation of the extra-embryonal mesoderm, cœlom and chorion, and the replacement of the vesicular allantois by the almost solid connecting stalk, all of them features in which Tarsius anticipates the Pithecoids.

(3) Certain definite advances on the Lemuroid, in particular the acquisition by the early blastocyst of a direct attachment to the uterine lining and the resulting formation of a massive discoidal placenta of the deciduate hæmochorial type. The development of the placenta is discussed and it is shown that the trophoblast is unique, both in its histological characters and in its behaviour. On these grounds the conclusion is reached that the Tarsius placenta is too specialised to have been the actual forerunner of that of the Pithecoids, but would seem to have developed along lines of its own, as a parallel formation. It is emphasised that the acceptance of this conclusion in regard to the placenta in no way lessens the significance of the Tarsioid phase as the most important transitional stage in the evolution of the developmental processes in the Primates. We have only to suppose that the Pithecoids took origin from another branch of the Tarsioid stock in which the attempt at the formation of a hæmochorial placenta proceeded along lines more comparable with those which we find in the existing Pithecoids, than does that of Tarsius.

Pithecoid Stage.—The justification for the recognition of this stage rests on the occurrence in the Platyrhine and Catarhine Monkeys of certain striking resemblances in their early development, all of them of the nature of definite developmental advances on the Tarsioid condition.

(1) The amnion no longer develops by fold-formation, since its cavity, the primitive amniotic cavity, arises as a closed

space, in the ectodermal cell-mass of the very early blastocyst.

(2) The primary attachment of the blastocyst to the uterine wall is always effected by the trophoblast over the embryonal pole. A second attachment is also usually formed at the anti-embryonal pole, in which case the placenta is bi-discoidal.

(3) The extra-embryonal mesoderm and cœlom and the mesodermal primordium of the connecting stalk are formed even more precociously than in the Tarsioid. The extra-embryonal mesoderm (the so-called primary mesoderm of the early human blastocyst) though homologous with that of the Tarsioid, is no longer of direct primitive streak origin, but appears to arise as in Hapale as a proliferation from the hinder margin of the shield-ectoderm and the adjoining amniotic ectoderm.

(4) The trophoblast always becomes clearly distinguishable into cellular and syncytial layers. The syncytio-trophoblast exhibits erosive and destructive properties, and has the capacity of proliferating and of penetrating more or less deeply into the maternal decidual tissue in the form of an irregular network. The existence of certain well marked differences in the behaviour of the trophoblast and in the structure of the placenta in the two groups of monkeys and the very striking similarities in the development of the placenta in the Catarhines and the Anthropoids suggest the conclusion that the Platyrhines separated very early from the parent stem to pursue a path of their own, whilst the Catarhines furnished the stock from which the Anthropoids originated.

Anthropoid Stage.—In this final stage in which we group together the Anthropoid Apes and Man, we see the culmination of developmental adaptation, so far as the Primates are concerned. Unfortunately, we have no knowledge of the earliest stages in the development of the Anthropoid Apes, but, thanks to the labours of Selenka and Strahl, we know enough of their later stages and placentation to justify the belief that their development conforms in all essentials to the human type, so that for the details of early Anthropoid ontogeny we depend on the work of the human embryologist. The outstanding feature of the early human blastocyst is its extraordinary precocity as exemplified, for example, in the relations it very early acquires to the uterine lining and in the remarkably early differentiation of its trophoblast and its extra-embryonal mesoderm. It is no longer content to undergo its development in the uterine lumen as does that of all the lower Primates, but, whilst still quite minute, burrows its way through the uterine epithelium and implants itself in the very vascular subepithelial decidual tissue of the uterus. Therein it forms for itself a decidual cavity and undergoes its subsequent development, completely embedded in the maternal tissue. In this way the Primate germ reaches the acme of its endeavour to maintain itself in the uterus and to obtain an adequate supply of nutriment at the earliest possible moment. And it is an interesting and significant fact that just as the Pithecoid blastocyst always attaches itself by the embryonal pole, so here that pole is the first to enter, so that the embryo lies on the deep side of the blastocyst in immediate proximity to the site of formation of the definitive placenta. Certain features, distinctive of the Anthropoids, are to be regarded as the direct outcome of this process of interstitial implantation and consequently, as purely secondary specialisations. These include (*a*) differentiation of a decidua capsularis from the decidual tissue covering the blastocyst; (*b*) formation round the very early blastocyst of a complete enveloping network of syncytio-trophoblast, possessing in even more marked degree than that of the Pithecoids, destructive and penetrative properties; (*c*) development from the chorion of the older blastocyst of a more or less uniform covering of chorionic villi. In the blastocyst itself, formation of the extra-embryonal mesoderm apparently takes place at such an early period that it is able to fill the minute cavity of the blastocyst completely as a delicate cellular tissue in which only later the cœlomic cavity appears.

Apart from these adaptive specialisations, the Anthropoid develops along the lines laid down in the Catarhine stock, and as the result of the atrophy of the chorionic villi originally related to the decidua capsularis and the growth of those related to the decidua basalis, forms a single discoidal placenta, the homologue of the primary placenta of the Catarhine

and differing from that only in minor details and in the rather more individualised character of its fœtal chorionic villi. Of the genetic relationship of the Anthropoid Apes and Man, and of these to the Catarhine stock, there can be no question on embryological grounds.

THE CHEMICAL SOCIETY.

Thursday, November 21.

The Rotatory Dispersion of Organic Compounds. Part. XIX. The Validity of Drude's Equation. By T. M. Lowry.

The squared term which Livens proposes to add to Drude's equation is too small to be detected in measurements of the rotatory dispersion of organic compounds, and is unproved even in the case of quartz.

The infra-red term postulated by R. W. Wood, and more recently by C. E. Wood and Nicholas, in transparent organic compounds which exhibit anomalous dispersion, is purely hypothetical, since no case is known in which the infra-red absorption bands of these compounds are optically active.

The theoretical deductions of Kuhn endorse the validity of Drude's equation and are in general agreement with empirical observations as to the sign and relative magnitudes of the partial rotations due to centres of fixed and of induced asymmetry.

The Influence of the Sulphur Atom on the Reactivity of Adjacent Atoms or Groups. By G. M. Bennett, F. Heathcoat and A. N. Mosses.

Phenyl δ-chlorobutyl and phenyl and methyl ε-chloroamyl sulphides have been isolated. Ethyl δ-chlorobutyl sulphide, on the other hand, cannot be distilled owing to the immediate formation of a cyclic sulphonium chloride by self-addition. The other chlorosulphides described undergo a similar ring closure in solution at 80°. Kinetic experiments show the reactions to be of the first order and that the 5-ring is formed 7·6 times as rapidly as the 6-ring.

Studies in the Penthian Series. Part II. Penthian-4-one. Part III. Stereoisomeric Derivatives of some Penthianols. By G. M. Bennett and W. B. Waddington.

A number of derivatives of penthianone were described, including *penthienoindole* obtained from the phenylhydrazone by the Fischer indole transformation. A crystallographic description of penthianone is recorded.

The sulphoxides of cyclic sulphides of the type $S<^{C_2H_4}_{C_2H_4}>CAB$ should occur in pairs of stereoisomerides analogous to the hexahydroterephthalic acids and to the dioxides of dithian. Complete crystallographic descriptions are recorded for two of these pairs of stereoisomerides.

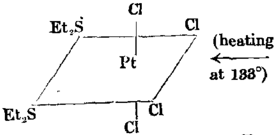
The *methyl sulphonium* salts and the *sulphilimine* of phenylpenthianol have also been studied from the same point of view.

A New Interpretation of the Isomerism Amongst Co-ordination Compounds of Platinum. By F. G. Angell, H. D. K. Drew, and W. Wardlaw.

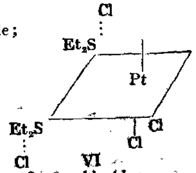
The isomerism of the α- and β-dichlorides produced from platinous chloride and diethyl sulphide has hitherto been explained (by Werner) as the *cis-* and *trans*-isomerism of a planar distribution of the four groupings around the platinum atom. The isomerism is now found to extend to the dibromides, di-iodides, and dinitrates of the α- and β-series. It is due, not to spatial, but to structural difference.

The α-compounds contain quadrivalent platinum united to the sulphur atoms by Sidgwick co-ordination linkings, whilst the β-compounds are of the sulphonium type in which chlorine is united to sulphur and is potentially ionised. The β-salts are electrolytes in aqueous solution; the α-salts are non-polar. Intertransformation between the two series takes place by migration of the acid radicals from platinum to sulphur or the reverse.

The behaviour of the α- and β-dichlorides towards moist silver oxide is strikingly distinct. The former by a slow interaction gives platinum oxide and free diethyl sulphide; the latter rapidly produces a strong base, *platinumbisdiethylsulphonium hy-*



V
(α-tetrachloride; octahedral)



VI
(β-tetrachloride; tetrahedral)

droxide, which is soluble in water in which it is an electrolyte. It neutralises acids yielding pure β-salts at temperatures below those of transition to the α-salts. The *oxalate* is ionised in aqueous solution.

The isomerism is shown, contrary to statements in the literature, to extend to the derivatives containing "sexavalent" platinum. The α- and β-tetrachlorides have been prepared by addition of chlorine to the respective dichlorides; they are intertransformable. The β-tetrabromide is even more labile than the tetrachloride.

The same dichlorodibromide is produced by adding bromine to the α-dichloride or chlorine to the α-dibromide. The corresponding additions to the β-halides give labile β-tetrahalides which are easily transformed to the same dichlorodibromide.

These transformations are explicable only on the assumption that platinum in the quadri-covalent compounds is tetrahedral and that conbesrion to the octahedral form takes place exclusively by *cis*-addition of the two further groupings. The six valency electrons of platinum have. therefore, fixed spatial directions which are the same whether one, two, or three pairs are saturated. Saturation occurs exclusively in pairs which occupy respectively the three *cis*-positions of the developed octahedron. If this be rigidly true or almost so, then it should follow that the skew tetrahedron represented by I and its analogues (or, on the alternative view, the octahedron bearing negative charges at two corners, the sulphur atoms being positively charged) should occasion molecular asymmetry. The possibility is being tested.

THE OPTICAL SOCIETY.

A meeting was held at the Imperial College of Science and Technology, South Kensington, on Thursday, November 14th, 1929.

The President, Mr. F. Twyman, F.R.S., was in the Chair.

Mr. A. G. Frewin of the Emil Busch Optical Co., Ltd., gave a short lecture on and demonstration of the following two instruments :—

The Busch Optometer, designed by Prof. Thorner.

This is an instrument for measuring objectively the errors of an ametropic eye. By it one can measure in diopters the hypermetropic or myopic of a symmetrical eye or the ametropic in the two meridians of an astigmatic eye, together with the directions of the two meridians. The patient looks with one eye into the exit pupil of the instrument, whilst the observer looks into the eyepiece and focuses on the patient's macula the image of the straight filament of a small electric bulb. The focusing hand moves a scale relatively to a fixed pointer so that when the side edges of the filament are sharp the ametropia may be read off at once.

Freedom from glare and corneal reflections is secured by two suitably arranged semi-circular stops which ensure that the illuminating rays are incident on the top half of the patient's cornea whilst the light, reflected from the fundees, which reaches the observer, issues from the lower half of the cornea. The patient's eye is adjusted so that the instrument measures the vertex power of the proper correcting lens when its vertex is placed 12 mm. in front of the patient's cornea.

2. A Glare-free, reflexless, stereoscopic hand opthalmoscope, designed by Prof. Thorner.

In the new instrument mirrors are used for illuminating the fundees and for reflecting its image into a binocular eyepiece so that the magnified image is seen in stereoscopic relief.

The fundus is illuminated by an image of the source of light focused on the lower half of the patient's cornea by a concave mirror. The optical system is such that the centres of the observers' pupils are conjugate with two separated points situated on the patient's cornea above the image of the source of light. The rays from the retina which pass through the right of these two points can only reach one eye of the observer, and those which pass through the left point can only reach the other eye, consequently the two eyes appear to see the retina from two points of view. The retina is therefore seen in stereoscopic relief. Rays reflected from the patient's cornea cannot enter the observer's pupils.

Mr. E. F. Fincham then described and demonstrated his "stereo-fixation device for campimeters."

In this device one eye is fixed on a stereogram at the centre of a chart being viewed, whilst the other is fixed on a stereogram which is reflected into it by means of a right-angled prism arrangement. When the two stereograms are

combined the eyes are in proper adjustment for viewing the chart.

The meeting concluded with the exhibition of Messrs. Bausch and Lomb's 3-reel, 16 mm. moving picture film illustrating the manufacture of optical glass. Messrs. Kodak, Ltd., kindly lent the projector and supplied an operator.

NOTICES OF BOOKS.

The Effects of Moisture on Chemical and Physical Change. By J. W. SMITH. pp. xii. and 235. London: Longmans, Green & Co. 1929. Price 15s.

It has been known for a long time that water, even in minute traces, is able to exercise a marked catalytic effect on the velocity of many chemical reactions. The researches of Prof. H. B. Baker and others on intensive drying have also shown that complete absence of moisture inhibits the reactivity of gases which are, under ordinary circumstances, readily reactive.

The author of the present volume (one of the series of text-books on Physical Chemistry, edited by the late Sir William Ramsay and Prof. Donnan) has made a very exhaustive search of the literature on the subject of the effects of moisture on chemical and physical change and presents an excellent summary of past observations and our present knowledge of the influence of traces of water vapour on chemical reactivity and on the physical constants of solids and liquids.

As in all specialised branches of science the experimental technique is exceedingly elaborate and numerous precautions must be observed in order to secure positive results the exact procedure in the more important sections has been given in detail. The author also discusses the theories that have been put forward to account for the phenomena dealt with. None seem adequate or satisfactory. Doubtless further investigations will shed more light upon the question and may lead to the formulation of the true explanation.

The monograph is of unusual interest and may be commended to the attention of physical chemists and others.

The Parachor and Valency. By SAMUEL SUGDEN, D.Sc. pp. vii. and 224. London: Routledge & Sons, Broadway House, Carter Lane, E.C. 1929. Price 12s. 6d.

Dr. Sugden has made a very close study of the Parachor during the last few years, and the scientific world will welcome this volume by him in which he gives a full account of the Parachor and its contributions to the theories of valency. He has set out the experimental evidence and then goes on to consider its implications, especially in connection with the interpretation of valency bonds in terms of electrons. It is perhaps not always realised that the development of the electronic theory of valency involves two separate problems which are not always clearly distinguished. The first is concerned with the number of electrons associated with a particular linkage and is the one which Dr. Sugden has discussed in the present volume. The second problem is that of the stability or reactivity of a molecule. This is determined not only by the number of electrons in a particular bond, but by the nature of the atoms linked together. Further, it sometimes happens that other factors have an important influence in this connection.

The parachor (a function of the surface tension and the density of a liquid), which approximates to an ideal additive property, is determined by the nature and number of the atoms and linkages in the molecule. It is thus useful as an experimental test of the many hypotheses put forward in connection with the electronic theories of valency.

The book, which is the second volume in Routledge's *Twentieth Century Chemistry* Series, edited by the late SIR WILLIAM TILDEN and PROF. J. C. PHILLIP, is of interest to all chemists and physicists who desire to become acquainted with the latest views on valency.

The Chemistry of Leather Manufacture. By Dr. J. A. WILSON. Vol. II. Revised edition, pp. 499-1181. New York. Chemical Catalog Co. 1929. Price 10 dollars.

It has taken Dr. Wilson well over 600 pages and nearly 80 chapters in which to complete the revised edition of his extremely important work for leather chemists and the leather industries generally. Every phase of leather manufacture and technology has been covered and the author has sought the co-operation of many colleagues in the trade to assist in making his *monograph* complete and up-to-date. That the book is written from a

scientific as well as a practical standpoint will be appreciated when it is mentioned that chapter 17 is devoted to chromium salts and much chemical theory is incorporated in the text.

Different type of leathers are shown by photo-micrographs of transverse sections of various hides and a chapter is devoted to an account of the microscopic examination of skins and leather. Patent leathers and furs are also the subjects of other chapters. *The Chemistry of Leather Manufacture* is one of the American Chemical Society's Monographs published by the Chemical Catalog Co., and these bodies and the author deserve the thanks of leather chemists and technologists for their excellent production.

Technical Chemists' Handbook. By GEORGE LUNGE, PH.D. Third Edition, revised by A. C. CUMMING, D.Sc., F.I.C. pp. xvi. and 262. London: Messrs. Gurney & Jackson, 33, Paternoster Row, E.C. 1929 Price 12s. 6d.

The *Technical Chemists' Handbook*, as its title implies, is mainly for works chemists, technologists and analysts. It is a valuable compilation of tables of important data and also describes the methods of commercial analyses. It aims further at effecting uniformity of procedure in the control of analytical methods and in testing products so that practical chemists, buyers and sellers, analysts and others using the same standards and methods, will always (within reasonable limits) obtain identical results.

In a book of this kind, accuracy in the numerical data is obviously of great importance and the errors noted in earlier editions have been corrected and many figures have been re-calculated.

The book falls into two parts. The first is concerned with 42 sets of tables of useful data, and the second (and larger) part is concerned with general chemical practice, *e.g.*, sampling, preparing standard solutions, and the methods of analysis of fuels, the substances employed and the products obtained in sulphuric acid manufacture, in the manufacture of the various alkalis, nitric acid, the products of the distillation of coal, fertilisers, the cement industry, etc.

Standard methods rather than *new* ones have been preferred, possibly to accord with the conservatism of many works chemists who do not generally favour changes unless the new method shows distinct advantages over the old. The book will soon establish itself among those to whom it is addressed.

A new quarterly Journal, *The Chemist and Druggist of India*, has appeared at Madras as the organ of the local Chemists' and Druggists' Association. In addition to business and professional matters there are one or two articles on scientific topics.

Forthcoming Events.

ROYAL INSTITUTION.

CHRISTMAS LECTURES.

Adapted to a Juvenile Auditory.

"How Things Were Done in Ancient Egypt." (One hundred and fourth Course of Six Illustrated Lectures.) By S. R. K. Glanville, M.A., of the Department of Egyptian and Assyrian Antiquities, British Museum.

The Lectures will be given in the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2. at 3 o'clock. Tickets may be obtained at the Royal Institution.

The Lectures and dates are as follows:—

(1) "The Elementary Use of Nature." (Saturday, December 28).

The habitable land of Egypt forms one of the richest soils of the earth; consequently agriculture has always been the mainstay of the Egyptians. They learn early to make the most of crops with extremely simple apparatus, for the land was easy to work; wheat, barley and flax thus supplied the basis of food and clothing, but the annual variation in the volume of the Nile's flood was a perpetual menace, and necessitated an elaborate network of irrigation. Fish and wild-fowl teemed in the river and its marshes respectively; methods of wholesale capture were early devised, and used together with the sportsman's fish-spear and throw-stick. The rocky desert which bordered the valley provided four-footed game of all sizes. Many species were snared for domestication.

(2) "Making a Home." (Tuesday, December 31, 1929.)

The first dwellings were little more than shelters from the North wind, made of reeds strengthened with mud. Portable houses made of wood were the next step; but the

permanent home came with the discovery that sun-dried bricks made a perfect building material in a country with next to no rainfall. Even such a house could be quickly demolished, and another erected elsewhere at comparatively small cost. In towns crowded street-plans necessitated cramped houses of two or three stories; in the country, where the largest estates were found, the bungalow was preferred. Such estates were largely self-supporting, and were managed by slaves and dependents under the supervision of bailiffs, who were personally responsible to the owner. If a private individual, the latter divided his time between the control of this organisation and the recreation of outdoor sport and entertainment at home, in both of which his family took their part.

(3) " Building in Stone." (Thursday, January 2, 1930).

The earliest stone buildings yet found imitate the technique of brick and timber constructions. The stonemasons soon escaped from these limits and discovered the wider possibilities of their material. In some ways they reached perfection in their craft with the Great Pyramid a development by discernible stages wrom a simple sloping-sided rectangular erection. The engineering difficulties encountered in building the Pyramid were met by the simplest mechanical means backed by practically unlimited resources in men and supplies. In the Pyramid age for the first time the Egyptians achieved a monolithic temple; this led to their supreme effort of engineering—the quarrying, transport and erection of obelisks several tons in weight and made of single pieces of granite. Their re-erection by later peoples at various times since has always proved troublesome. In comparing the various methods used it is seen that the man-power necessary for the task has consistently decreased.

(4) " Boats and Furniture." (Saturday, January 2, 1930).

The first boats were little more than rafts, made of bundles of papyrus-stems bound together. By means of rope and pressure in the stocks the ends were turned up and thus the typical shape of the Nile boat was fixed, and was adopted by the small type of wooden boat. The bulk of the river-going craft was made of native wood—acacia from which only short lengths were obtainable. Hence the " brick-wise " method of ship-building peculiar to the Egyptians. For ladger, especially sea-going vessels, deal from the Lebanon mountains was imported. Foreign timber was also used for the finer coffins and for furniture. Considerable skill in joinery was acquired, largely owing to the lack of nails and the screws and the consequent need to make all joints firm by means of tenons and dowels. A faid range of tools was available, including the drill. The idea of the handled hammer entirely escaped the ancient Egyptian. As to-day, the adze was his most useful tool.

(5) " The Workshops." (Tuesday, January 7, 1930.)

The Egyptians were born craftsmen. Before the historic period began they had achieved a skill in flint-working equalled nowhere else and at no other time; they had produced pottery surpassed by none; with elementary tools were making vases of hard stone which would rouse admiration if made to-day; and had discovered how to glaze small objects. The last craft was elaborated under the dynasties and contributed largely to the brilliance of the jewellery which was the pride of the goldsmiths. It came to its full glody with the production of variegated glass in the XVIIIth Dynasty. Most of our information of these crafts is derived from representations of them on the wall-paintings of tombs. The men responsible for these paintings and reliefs were themselves craftsmen of a high order, and a good deal can be inferred as to the technique of their work. They were closely allied to the sculptors whose products were rarely considered finished till thev had been painted.

(6) " Hieroglyphs." (Thursday, January 9, 1930.)

Writing started with simple pictures representing objects and simple ideas. Then a picture came to stand not only for an object but also for the sound of the word for that object. This principle established, all sounds could be pictured; next the pictures were simplified so that they could be drawn quickly; finally they were so cut down as to bear little or no resemblance to the original pictures. Thus our own alphabet was formed. The Egyptians used a large number of pictures for their writing, and many of these throw light on their cussome. From early times inscriptions were cut or painted on stone monuments, but the writing material of daily life was papyrus or leather for important documents, and broken fragments of stone or pottery for less serious business. Papyrus made of slices of the stems of the papyrus plant, though produced in large quantities, never became cheap and was generally re-used

several times. The professional scribe or clerk carried a complete outfit of writing materials with him, including a combined ink-pot and pen-case.

SOCIETY OF PUBLIC ANALYSTS.

Wednesday, December 3, at 8 p.m.— A Lecture will be given by Professor A. P. Laurie, M.A., D.Sc., on: "The Methods of Examining Pictures." The following papers will be read if time permits:— "The Determination of Minute Amounts of Iodine in Soils and Waters." By R. L. Andrew. "The Quantitative Analysis of Mixtures of Nickel and Cobalt." By S. Glasstone, D.Sc., and J. C. Speakman.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2

Monday, December 2, at 8 p.m.— (Cantor Lecture.) E. G. Richardson, B.A., Ph.D., D.Sc.: "Musical and Scientific Aspects of Wind Instruments." (Lecture III.)

INSTITUTE OF RUBBER TECHNOLOGISTS.

Manchester Cafe, Ltd., Exchange Buildings.

Friday, December 6.—"Works Control in the Rubber Industry." By H. C. Young.

INSTITUTE OF CHEMISTRY.

Friday, November 29, at 5 p.m.—"The Professional Aspects of a Career in Chemistry." By R. L. Collett. (In the Chemistry Department, Queen's University.)

FERTILISERS MANUFACTURE IN CANADA.

Factories to be Established in Ontario and Quebec.

An announcement was made recently of the intention of the Consolidated Mining and Smelting Company of Canada, Ltd., to spend between $8,000,000 and $9,000,000 on the establishment of a fertiliser plant at its immense smelter at Trail, B.C., in order to produce super-phosphate and other manures for distribution on prairie farms.

Another important company, namely, Canadian Industries, Ltd., has now come into the fertilisers field with a decision to engage in the manufacture of fertilisers on a large scale at Hamilton, Ontario, and Beloeil, Quebec, as well as from the existing factory of the Triangle Chemical Company in British Columbia. The latter concern is at present stated to be the only company actively concerned in the manufacture of super-phosphates in Canada, but according to an announcement just made by Canadian Industries, Ltd., the new factories will turn out super-phosphate and fertilising mixtures adapted to soil and crop conditions in the respective provinces, and in this venture will have the technical and commercial backing of Imperial Chemical Industries, Ltd., in Great Britain.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

33,815.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.)—Manufacture of naphthalene-sulphonic dicarboxylic acids. November 1.

32,962.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogen derivatives. October 30.

33,314.—I. G. Farbenindustdie Akt.-Ges. —Manufacture of stable acridine salt solutions. November 1.

32,834.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs. October 20.

33,314.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of N-monoacylated diamino-arsenobenzenes. November 1.

289,094.—Soc. of Chemical Industry in Basle.—Manufacture of dyestuffs.

296,049.—Soc. Chimique de la Grande-Paroisse Azote et Produits Chimiques.—Process for the production of oxygen-containing organic compounds.

307,484.—Hefti, F.—Process for the production of a barbituric acid compound.

299,332.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo-dyestuffs.

Abstract Published.

319,025.—Diolefines.—Johnson, J. R., 47, Lincoln's Inn Fields, London. (I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Diolefines are separated from gaseous or liquid mixtures thereof with mono-olefines or saturated hydrocarbons, by treatment with certain specified solvents which dissolve the diolefines more readily than the other constituents, and from which they may be recovered by heating. The specified solvents are glycolchlorhydrin, glycol monoacetate and diacetate, glycolmonomethyl ether, glycerol diacetate and triacetate, lactic acid nitrile, diethyltartrate, furfural, and aromatic bases such an aniline, toluidine, or phenylhydrazine. Mixtures of these solvents may be employed. The treatment may be carried out at atmospheric or higher pressure, and the mixtures treated may contain hydrogen and other substances, in addition to diolefines and monolefines or saturated hydrocarbons. Liquid mixtures, such as one of isoprene and pentane, may be shaken up with the solvents, the two layers formed may be separated, if necessary by cooling, and the constituents recovered in auy suitable manner. Gaseous mixtures such as one of butadiene and butylene, may be passed through the solvents, the diolefine recovered by heating the solution being condensed, and the process may be repeated; or the separation may be effected by passing the mixture through a scrubbing towen in countercurrent to the solvent. Specifications 10701/09 and 156,123 are referred to.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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THE REMOVAL OF INTERFERING ACIDS PRIOR TO SYSTEMATIC METALLIC ANALYSIS.

By L. J. CURTMAN AND M. WIGLER.
(College of the City of New York.)

INTRODUCTION.

In the systematic qualitative analysis of unknown mixtures, the conventional procedure is first to test for the metals and then for the acids. With two exceptions[1] all the text-book writers follow this order. This sequence undoubtedly makes for simplicity where the unknowns are limited to simple compounds or to comparatively simple combinations of salts. Where, however, complex mixtures are to be analysed, it is necessary at various points in the systematic analysis for metals to test for certain interfering acids. If these are found, provision must be made for their removal before the metallic analysis is resumed. Since the number of interfering acids is much larger than is commonly supposed, it seems to the authors more logical to reverse the conventional order and to test for the acids first.

Consider the following acids commonly found in mixtures; acetate, arsenate, arsenite, borate, bromide, carbonate, chlorate, chloride, chromate, cyanide, ferrocyanide, ferricyanide, fluoride, iodide, nitrate, nitrite, oxalate, phosphate, silicate, sulphate, sulphide, sulphite, tartrate, thiocyanate, and thiosulphate. Of these twenty-five acids, only chloride, sulphate, arsenite, carbonate and acetate[2] offer no interference in the

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[1] Dales and Barnaby (*Elementary Qualitative Analysis*, Wiley & Sons, 1916, p. iv) state: "Inasmuch as the detection of the acids requires much less time than that of the bases in the ordinary analysis for the common elements and likewise as the elimination of the bases saves many more steps in the systematic analysis, we recomment the detection of the acids first." We believe this order is the logical one for reasons which we have given above and not for those stated by Dales and Barnaby.

Gardiner (*Chemical Analysis*, 1914, p. 437), considers it "most convenient to establish the presence or absence of a phosphate, borate, fluoride, silicate, cyanide or complex cyamide, then to proceed to the examination for metals."

[2] In a paper shortly to be published, it will be shown that acetate and other weak acids when present in maximum quantities (500 mg.) offer no practical interference in the preliminary adjustment of the acidity as well as in the complete separation of metals of Group II from those of Group III by means of H_2S.

analysis. The others interfere in the following fashion :—

1. Phosphate, fluoride, oxalate, borate (in the absence of NH_4 salts), silicate and tartrate interfere with the metallic analysis by causing metals of Group IV and Mg to precipitate in Group III. Tartrates also have a disturbing influence on the precipitation of Al and Cr in Group III.

2. Nitrate, nitrite, chromate and chlorate oxidise the H_2S in acid solution, giving a precipitate of sulphur which masks results and obstructs the process of analysis. Chlorate also forms explosive decomposition products when treated with strong acids.

3. Sulphite and thiosulphate also react with H_2S, yielding a precipitate of sulphur.

4. Iodide and bromide, if present in large amounts, will partly undergo oxidation by the HNO_3 added in Group III to oxidise the ferrous iron. The halogens set free under these conditions are likely to form explosive nitrogen compounds when the solution is subsequently treated with an excess of NH_4OH. Iodide, moreover, interferes with the sodium cobaltinitrite test for potassium.

5. Arsenates when present in large quantities are difficult to precipitate with H_2S. If not reduced and precipitated in Group II, they pass into the third group where they interfere with the metallic analysis in the same manner as do phosphates.

6. Cyanides are dangerous to work with because of the formation of HCN when their solutions are acidified. Their strong tendency to form complex cyanides is, moreover, a disturbing influence in systematic metallic analysis.

7. Thiocyanates are undesirable because of the colour interferences they produce with metals like iron.

8. Ferrocyanides and ferricyanides interfere by the formation of compounds which are difficult to dissolve. When present in soluble combinations they interfere by forming a blue precipitate when the solution is acidified with a strong acid and the mixture heated. It is therefore imperative to remove these complex cyanides before beginning the systematic analysis for the metals.

Since, as shown above, the great majority of acids offer some interference in the systematic analysis for the metals, it is preferable to test for the acids first. Moreover, a knowledge of the acids contained in a given unknown will enable the analyst to simplify his procedure for preparing the solution for metallic analysis. It was the object of this investigation to devise a method which, in as few steps as possible, would eliminate all the interfering acids.

Experimental.

Action of Sulphuric Acid on Various Salts. It was expected that many of the interfering acids could be removed by suitable treatment with H_2SO_4. Accordingly, a number of experiments were made employing the following procedure : In a casserole, 500 mg. of the acid radical in the form of the compound mentioned in column 2 (see table below) were treated with 18 cc. of 6*N* H_2SO_4, the mixture boiled down to the fuming point and the heating continued for 2-3 minutes after dense opaque fumes of SO_3 appeared. While fuming, the mixture was agitated by imparting a rotary motion to the casserole and by stirring. The results obtained are given in the following table.

Table 1.

1	$K_4Fe(CN)_6.3H_2O$.—Yields a white residue insoluble in water but soluble in hot HCl. Analysis showed the presence of NH_4, SO_4 Fe and K, but no cyanide. The complete decomposition of the ferrocyanide was indicated by the failure of the mixture to yield a blue precipitate or colouration on diluting the mixture with water.
2	$K_3Fe(CN)_6$—Same as in 1.
3	KBr—Bromide completely removed after fuming for 3 minutes.
4	KI—Iodide completely removed. The iodide globules should be stirred vigorously in order that they may be vapourised.
5	$K_2C_2O_4.H_2O$—Oxalate completely destroyed as shown by the negative test with addition of a drop of N/10 $KMnO_4$.
6	$KNaC_4H_4O_6.4H_2O$—Pitch black residue of carbon.
7	Na_2SO_3—Sulphite completely removed.
8	$Na_2S_2O_3.5H_2O$—Thiosulphate completely destroyed, small ball of sulphur removed with glass rod.
9	KSCN—Thiocyanate completely removed.
10	KNO_3—Nitrate completely removed.
11	$NaNO_2$—Nitrite completely removed.
12	NaF—After 4 minutes of dense fuming, mixture gave negative etching test. The latter is easily sensitive to 1 mg. of F. Casserole was slightly etched.
13	$Na_2HPO_4.12H_2$—Large proportion of the PO_4 was removed but sufficient remained to yield a heavy precipitate with ammonium molybdate reagent.

14 $Fe_4[Fe(CN)_6]_3$ — Ferrocyanide completely removed.
15 $Cu(CN)_2$—Cyanide completely removed.
16 $Ca_x(NH_4)_yFe(CN)_6$ — Cyanide completely removed.
17 $Zn_2Fe(CN)_6$—Cyanide completely removed.
18 HgI_2—Iodide completely removed by vigorous stirring while fuming.
19 CaF_2—Fluoride completely removed by fuming for 4 minutes. The casserole was etched traces of Al and Fe going into solution.
20 $CrPO_4$—No effect on fuming slightly. The usual procedure of fuming strongly for 2 minutes results in the formation of an insoluble, anhydrous, colloidal sulphate.
21 $KClO_3$—Chlorates completely removed.
22 $NaClO_3$—*Same as in* 21.
23 K_2CrO_4—No effect.
24 $Na_2HAsO_4.7H_2O$—No apparent change.
25 $NaAsO_2$—Arsenic volatilised more or less completely depending upon the duration of the fuming.

COMMENTS.

The results in Table I show that all the interfering acids are removed except PO_4, $C_4H_4O_6$, CrO_4 and AsO_2. Silicates would also not be destroyed, the latter requiring the use of HF in a platinum vessel. Phosphates need not be removed at this stage since they are conveniently separated by means of $ZrOCl_2$ (Curtman, Marlies & Plechner, *Chem. News*, 1924, cxxxix, 315), in the filtrate from Group II.

Action of a Mixture of H_2SO_4 *and* HNO_3 *on Various Salts*.—For tartrates and other forms of involatile organic matter the following procedure was employed: To 500 mg. of the acid radical in the form of a salt and contained in a casserole, were added 18 cc. 6N H_2SO_4 and 10 cc. 15N HNO_3 and the mixture heated until fumes of SO_3 were given off. After cooling, another portion of HNO_3 was added and the mixture heated to the fuming point. The addition of HNO_3 and the fuming were repeated until a straw-coloured solution was obtained. The mixture was finally strongly fumed for 2-3 minutes. The results are given in Table II together with those obtained when these conditions were applied to some of the acids considered in Table I.

TABLE II.

1 $KNaC_4H_4O_6.4H_2O$ — A straw-coloured solution was obtained after 4 treatments with HNO_3.
2 $CuC_4H_4O_6$—A light green coloured solution was obtained, a mixture of the blue Cu ion and the straw colour
3 $K_2C_2O_4.H_2O$—*Completely removed.*
4 KI—The presence of HNO_3 facilitates the removal of iodides, but vigorous stirring while fuming was necessary.
5 $Fe_4[Fe(CN)_6]_3$—Completely destroyed.
6 $Cu(CN)_2$ — Cyanide completely removed..
7 $Na_2HAsO_4.2H_2O$—Unaffected.
8 $NaAsO_2$—A considerable portion of the arsenic was volatilised. A large amount remained behind as arsenate.

COMMENTS.

The results in Table II show that involatile organic matter may be completely destroyed by a combination of H_2SO_4 and HNO_3. The latter, however, possesses the disadvantage of oxidising a considerable portion of any arsenite that may be present. Hence, when this procedure is employed provision must be made for subsequently reducing or eliminating arsenates.

(*To be continued.*)

MATTER AND LOGIC.

By DR. W. TOMBROCK.

Our First Principles and our Final Conclusion.—General Résumé.

I have in my young days more than once been able to observe among my colleagues a distrust of speculative philosophy, a distrust which through incomplete insight, also was directed to logic itself. This latter is completely absurd. Without logic and common sense no scientific system can indeed exist.

An example of this surprising distrust of logic, even where this lay on mathematical territory, can be instanced from my own experience. One sought to measure the potential difference between two electrolytic solutions . . . the potential difference between solutions of one and the same electrolyte of different strengths, of $ZnSO_4$ for example. One sought and sought but could see no result. And yet this result was perfectly simple. If one calls the required potential difference x, then we have approximately :

$$x=\tfrac{1}{2}(E_1+E_2)$$

in which E_1 and E_2 are the electromotive forces of two simple electrolytic cells. See Ernst Cohen and W. Tombrock, *Zeitschr. f. Elektrochemie*, *13*, 612 (1907) or Ernst Cohen, F. D. Chattaway and W. Tombrock, zur Thermodynamik der Normalelemente, dritte Mitteilung, in *Zeitschrift für Physikalische Chemie*, LX, 6. Also van Laar, *Sechs Vortrage über das thermodynamische Potential*, Braunschweig, 1906, p. 110.

I will not further explain the question

whoever is interested in the point, however, may consult the above mentioned literature. But *one can, without being a specialist*, very well see that the solution has been very simple: $x = \frac{1}{2}(E_1 + E_2.)$ And yet the question *appeared* to be *very complicated*. One sought it for long, and tried the most ridiculous combinations in order to arrive at it. And now this: when once the solution was obtained, as simple as the egg of Columbus, a German specialist happened to call it, then there was more than one who mistrusted this solution, mistrusted because of its simplicity, because of its logic, because of its common sense. It is strange but that *is* my personal experience.

And for this reason, because I thus believe that mistrust will again arise against the surprising results of my discussion in the *Chemical News*, it may be permitted for me summarising to refer once more to the beginning and the end of these discussions. Incidentally it may be remarked that it was the external aspect of present day physics —qua theory—which impelled me to these discussions. Indeed the difficulties in modern physics are such that some physicists have even come to deny matter and others think that one can no longer solve any physical problems by means of mechanical ideas.

We thus begin once more at our beginning.

Have you ever observed a movement *without* there being something which moved?

No, that *something* thus exists, it exists by observation and belongs to *empirical* knowledge; we call it *matter*, it has become our fundamental definition. *Matter is that which moves* — the substrate of physical phenomena.

Have you further ever observed that two material things simultaneously occupy the same place?

The apparent contradiction to this in the phenomenon that the total volume of two liquids sometimes becomes less after mxing, will not, however, disturb you I hope. Also although atoms, protons and electrons are thought of as being so small, they *cannot* simultaneously occupy the same place, for how do you then explain collisions among larger aggregates of matter, among objects observable to the senses? The supposition that the property, that two material particles cannot simultaneously occupy the same place, would first make its appearance with larger aggregates of particles will not do here. That can indeed hold, for example, with compressible substances . . . even the proton can be compressible

but this cannot hold in the remaining case. That the single particles should so behave that they can indeed when separate simultaneously fill the same space but that complexes of them could not do this, is just as difficult to grasp as that one could form a number by adding up noughts.

We thus accept that *matter moves and two material particles cannot simultaneously occupy the same place*.

Besides these starting points taken direct from empirical observation, we took as a guiding principle in our discussions:— *as few hypotheses as possible* and *exclusion of all that is not completely understandable*, as far as the fundamental matters and concepts are concerned. Whilst undoubtedly the maxim, attributed by us to Bacon, played a part as well, that with increasing complexity of matter, its properties also take on a more diverse and complicated character.

With this we did arrive at the *discontinuity of matter*, there must be discontinuity otherwise no motion could exist. *Matter thus consists of small particles—the* atoms of Democritus. The ether must also consist of them.

Next by further considerations *àpropos* of our present-day natural knowledge, we come to this important *hypothesis*:—

Protons, the constituents of the chemical atom, are ether-whirls.

And this hypothesis on further consideration furnishes us with the very probable result that forces—undoubtedly originating in the conception of Empedocles—*qua tales* do *not* exist. All observable material phenomena will be able to be explained by the mechanism of the cyclonic protons: the motions of these ether-whirls are the true cause of the observed effects. With moving material particles and their collisions—if necessary, if you wish, by means of the *resistance-forces* called into play by these collisions—you can arrive at them; our *extra* forces are unnecessary.

That is all.

We thus arrived at a great elucidation, at any rate simplification, of the underlying mechanism of natural phenomena; *there are no real forces*, unless one would attribute a real existence to the *resistance-forces* in a collision of material particles; nevertheless these resistance forces are then at any rate secondary, they do *not* cause the collision, but are produced by it; they are thus rather of a passive than an active character . . . in other words a real attraction between material particles towards points which appear to be attraction centres does indeed not exist. These streams are, as a reaction

cause movements of larger-grained material complexes *appear* to attract one another. Put more briefly :— the proton *is* a centre of motion, it thereby *appears* to be a centre of attractive force.

That is all.

In place of rejecting matter *qua talis*, we thus do better to reduce to its real value and significance the concept of " force " introduced by us. It sometimes seems as if we still in our subconscious mind let Empedocles' " love and enmity " play a part here. How comes it otherwise that we have yet not the faintest idea of a mechanism by which these so long naturalised " forces " act? Yet even appear practically not to have tried to form a conception of it? Let us first make sure of really understanding our forces, before we think of throwing overboard the matter with which we have worked always and with success. Our work is not yet finished by a long way. First overtake the true, real significance of our forces, first understand the mechanism by which they act, or at any rate appear to act; they can in spite of the external appearance be little more than fabrications, can they not?

But to throw matter overboard . . . have you, once more, ever observed a movement without there being something which moved? . . . to deny matter means denying objective empirical experience, means little other than banning logic and common sense for good from the territory of our natural science.

In reading through the foregoing pages, I feel two characteristic objections against it arise. The first is this' is it not really a bloomer to explain gravitation, for example, by . . . ignoring it? The second is : You qualify our forces as passive, as imaginary, fictitious, even as unreal, but . . . is there really anything else quite so real as the weight of a thing? The answer to the second question or objection covers at the same time the answer to the first of these questions. The answer is : There is indeed practically nothing else which is so real as a weight or as a fall. But these two things are observations or phenomena, if you would have it so, and *force* is an explanatory *hypothesis*.

Gravitation acting as an " attraction " has absolutely not been proved, it is an hypothesis and it remains an hypothesis however deeply rooted the concept may be with us . . . just reflect upon it, gravitation could just as well be a " pushing " force, urging bodies towards the earth, as an attractive force. In any case the ether must play a part in it as the medium, what part is that? Pressure towards the earth, thus a " push " force or . . . what else? Now you do *not know* that and in so doing gravitation *qua attractive force* is and remains *an hypothesis*.

Now over against this hypothesis of attractive force, not only of gravitation but also of other physical or chemical forces, we put the *hypothesis* that the *proton* is a complex material unit in a cyclonic form of motion.

We thus put a *single* hypothesis concerning the states of motion of the ultimate material particles against the hypotheses of all kinds of forces. This hypothesis gives us an explanation of these phenomena which make us think of forces.

But your hypothesis, as an explanation, is to a high degree fantastic, and our forces, think of gravitation particularly, are *not fantastic*.

Allowed.

But against this argument there is the fact that our hypothesis, however fantastic it may be, is *completely* understandable to you, and forces, certainly your gravitation, as an attractive force, you do *not* understand. You say that it is by an elastic tension in the ether that the gravitational phenomena can be explained?

A subterfuge! . . . since you *cannot* understand this tension either . . . on further consideration you will understand such a tension to an even less extent. Your gravitation is an hypothesis which contains *no* explanation, an aid to the imagination, which pictures or describes the observed phenomena, but which certainly does not give any explanation, *any cause*.

And our protons *do* this, although they are highly fantastic to you . . . honestly. *Vere scire est per causas scire*. True knowledge is knowledge of the causes.

We conclude finally that with our definition and primary property of matter taken directly from practical experience, by the assumption of cyclonic centres of motion of the ultimate material particles we can arrive at a perfectly understandable explanation of fundamental natural phenomena.

The incomprehensibility of a non-material substance in physics disappears . . . the dualism immaterial side by side with material disappears, the ether becomes material. We here point out once more the striking analogy between sound and light, to which less attention has been paid than to the difference between these phenomena. *In doing so the ether becomes understandable.*

Also the surprising dual character of light and other radiation phenomena—emission and undulation—then becomes understandable or at any rate one has a superficially plausible explanation for it.

Finally the active natural forces, which direct motion, which are real, and considered more closely are as yet completely incomprehensible, physically and chemically, disappear as well. Whoever will not give up this conception and would attribute the effects to *resistance forces* through the collision of material-particles, can if he wishes, deduce all physical and chemical forces from the above-mentioned resistance forces. By which means that which was incomprehensible in force is shifted on the primary property of matter, proposed on the basis of empirical observation, namely *that of the impenetrability of the ultimate particles* : . . . material particles cannot simultaneously occupy the same place.

So we may say that all that which is here *incomprehensible in our fundamental explanation* of nature, fades away as a morning mist as there breaks through the light of a new conception of the proton.

Our physical and chemical knowledge of nature can be fundamentally perfectly explained by means of the motions of particles, which cannot simultaneously occupy the same place and among which the protons function as complex material units in a cyclonic state of motion, while the electrons appear as larger simple particles.

Bergen op Zoom,
Holland.
November, 1929.

"HIS MASTER'S VOICE."

Visit to Hayes Factory by South-West London Chemists' Association.

Members of the South-West London Chemists' Association visited The Gramophone Company's Hayes Factory on Wednesday, November 13th. The tour was organised, in conjunction with The Gramophone Company, by Mr. H. G. Tibbett, the Honorary Secretary, of Wandsworth Bridge Road, and included in the party of some 50 members were the President, Miss A. T. Borrowman, The Pavement, Clapham; Mr. F. G. Wells, the Honorary Treasurer, of Bridge Road, Battersea; Mr. J. E. Jones, Honorary Social Secretary, of South Lambeth Road, and Mr. J. E. Monaghan, the Honorary Sports Secretary, of Balham High Road. A very interesting tour was made of the sixty acres of the most up-to-date works in the world, where 8,000 people work in ideal conditions. The departments inspected under expert guides included the machine factory where metal is cut, pressed and cold drawn by powerful pnnches. In this department are made the delicate tone arms and the thoroughness of the operations was demonstrated. In the plating department the visitors saw how parts are washed in caustic, sonax, water and cyanide baths, and then receive an eight hours' nickelling immersion. On another floor it was explained that a metal diaphragm is seven-thousandths of an inch thick—or should one say thin? The perfection of the adjustment of electric motors was emphasised and the marvels of the automatic lathe room were revealed. Here steel rods are fed into machines and automatically turned into screws and nuts, while a loud tone tungstyle needle is fashioned in sixteen seconds. This room particularly impresses as an example of how "His Master's Voice" makes everything to the smallest part and makes it with scientific certainty, so that it will stand long and hard usage. The creation of gramophone cabinets of many shapes and sizes was explained from the raw oak and mahogany to the polished, finished article.

In the generating station it was stated that The Gramophone Company at Hayes generates more power than is required to supply the town of Reading. Last year 11,000,000 units were generated and an average household consumes 1,000 units a year. The pressing of "His Master's Voice" records forms a fascinating study and the guests were interested to learn that before a disc leaves the works it is tested for twenty-four types of faults in addition to visual inspection.

The Canadian Department of Mines has issued a booklet entitled "Investigations in Ceramics and Road Materials," pp. 80, of interest to chemists and technologists connected with these industries.

The youngest University, that of Reading, is making an appeal for funds to carry out an extension programme estimated to cost £200,000.

CHEMISTRY AT THE WORLD'S FAIR.

The close connection of chemistry with the necessities and luxuries of modern life and the steady progress which the British Chemical Industry is making, on both scientific and utilitarian lines, will be demonstrated in the British Industries Fair, Olympia, London, from February 17th to 28th, when the exhibit held under the auspices of the Association of British Chemical Manufacturers will be on the ground floor in the annex of the Main Hall.

The exhibit will cover all branches of the industry, including heavy chemicals, fertilisers, explosives, coal tar derivatives, fine chemicals of all kinds, medicinal, pharmaceutical, photographic and analytical, perfumery chemicals, solvents and dyestuffs.

"The general impression in every branch," the organisers state, "will be found to be improved quality at reduced prices, together with a rapidly growing list of new products. It will be demonstrated that the British chemical industry, working along logical and scientific lines, is well in the forefront of the latest developments.

"Anyone seriously interested in the commercial applications of chemicals will find a visit to the Fair well worth while. The Association will have an office at Olympia for the period of the Fair, where inquiries may be made and the Association's six-language directory consulted. The British Chemical Plant Manufacturers' Association will also have an office in the section where members' catalogues may be referred to and appointments with members arranged."

Some notes on the exhibits of various branches of the industry follow :—

Heavy Chemicals and Fertilisers.

Even in this field where the British products have a world-wide reputation, advances will be shown. The common acids and alkalies will be available in the now familiar form of special strengths and qualities exactly suited to every special purpose, the industries catered for including soap, glass, paper, artificial silk, iron and steel, galvanising, etc. Bleaching materials are included in this section for makers of textiles, soap, sugar, glue, while a feature of interest is the progress made in special brands and packages for tropical conditions.

Among fertilisers, perhaps the most interesting innovation will be found in the fact that steps are now being taken to try out on a practical scale those artificial manures which are gradually becoming such an important alternative to natural materials.

Coal and Coal Tar Products.

The products recovered from coal are now well known even to the general public, including as they do fertilisers, motor fuel, disinfectants, and the raw materials for dyestuffs, explosives, and insecticides. Considerable interest attaches to recent improvements in road tar and tar-bitumen compounds of absolutely reliable standard, and tar emulsions for cold application, and the arrangements which can be offered in the matter of deliveries and for spraying from modern road tanks. Mention must be made of the new uses which are being found for creosote and its application to wood.

Medicinal and Pharmaceutical Chemicals.

The fine chemical industry will be especially well represented and will demonstrate the remarkable contribution to the re-establishment of British trade which, it is claimed, it has been enabled to make under the encouragement of the Safeguarding of Industries Act. Great interest attaches to the latest products for medical and therapeutic use, made under carefully controlled conditions and close Government supervision. Two recent compounds of interest have given excellent results in the treatment of colds and influenza, and in the fight against maternal mortality. The usual pharmaceutical products such as anæsthetics, antiseptics, alkaloids, drugs, gland extracts and vitamin substances, will be shown in all kinds of packages ready for every kind of treatment in any part of the world. The new arsenic preparations used in the treatment of tropical diseases, sleepy sickness and dysentery will also be shown.

Photographic Chemicals.

The range of photographic chemicals available will meet the needs of the process engraver, the radiologist, the plan producer, as well as the professional or amateur photographer.

Analytical and Research Chemicals.

The laboratory and analytical chemicals produced by British manufacturers can

now stand comparison with the products for which at one time it was considered essential to go abroad. There is a growing list of reagents specially prepared for particular purposes, and inquiries for new products of this kind will be particularly welcomed. This group also includes the microscopic stains and dyes, in the forms needed for all branches of research.

Perfumery Chemicals and Essential Oils.

The range of synthetics and isolates is being extended almost daily, and the display of products with special properties should be worth investigation by anyone interested in the compounding of perfumes, who wishes to keep up-to-date. Essenees for flavouring will be available specially prepared to comply with the Statutory regulations as to purity in any country.

Rare Earths.

The rare earth industry is now firmly established in England, and is able to offer a wide range of compounds for gas mantles, electric lamps, arc-carbons, glass and ceramics and pyrophoric alloys. One rare earth compound, mesothorium, is used medicinally, and also as an Empire substitute for radium in luminous paints.

Solvents.

A section of growing importance is the production of new and improved solvents for fats, gums, oils, and also for plasticisers for the lacquer and varnish trades. The perfumery, soap, laundry and dry-cleaning trades will also be interested in these developments. As each product has special properties, a detailed deseription is obviously impossible.

Dyes, Intermediates and Allied Products.

The British Dye Industry will be able to show once more the advances it has made, these being attributed by the Association to the assistance of the Dyestuffs (Import Regulation) Act. Fabric colours, though very important from the point of view of clothing and other materials, form only a portion of the types available, which include such widely different uses as leather, soap, inks, varnishes, rubber, films, cellulose lacquers, lakes, buttons, ivory, bath salts and paper. Food-colouring matters are becoming increasingly important and have to be specially prepared to conform to the very strict regulations imposed by most countries. Mineral colouring matters for use in the glass, ceramic and rubber industries are also found in this section.

Synthetic Resins.

Moulded articles made from synthetic resins are gradually finding favour on account of their resistance to wear, appearance and insulating properties. A moulding plant in actual operation, with a comprehensive exhibit of articles made in this way will show the extensive range indicate the possibilities of such materials.

Miscellaneous Chemicals.

Many products not easily classified under one or other of the above headings, such as stone preservatives, special chemicals for electro-plating, including chromium plating, will also be shown. Indeed, it is stated that every industry will find the chemicals it requires in the Chemical Section of the Fair—British-made and of British quality.

INCREASING OUTPUT FROM CANADIAN METAL MINES.

Available statistics of mineral production of Canada for the first half of this year show that there has been a marked general increase over the production for the first half of 1928, and that there is a likelihood that the total value of the production for 1929 will exceed $800,000,000.

The most important metallic minerals of Canada are copper, gold, nickel, leal, silver, and zinc, and for all of these except silver there was an increase in the value of production during the first six months of the current year. The greatest increase was made for copper and nickel, due both to greater quantity production and to better prices for copper.

Certain developments in the mineral industry that cannot be expressed in production figures are of great interest. Work is proceeding in connection with the erection of metallurgical plants in the Sudbury district, Ontario, that will when completed result in a greatly increased output of copper and nickel and the associated precious metals.

GENERAL NOTES.

EXEMPTIONS FROM KEY INDUSTRY DUTY.—CHEMICALS.

BOARD OF TRADE ANNOUNCEMENT.

The Treasury have made an Order under Section 10 (5) of the Finance Act, 1926, continuing the exemption from duty of methyl chloride till 30th June, 1930, and of the following articles till 31st December, 1930 :—

Acid hydrocyanic anhydrous; acid lactic which satisfies the requirements of the British Pharmacopœia; acid oxalic; amidopyrin (pyramidon; dimethyl-amido-antipyrine); ammonium perchlorate; barbitone (veronal; malonal; malourea; acid diethyl barbituric; diethylmalonylurea; hypnogen; deba); bromural (dormigene); celtium oxide; chinosol; cocaine crude; dial (acid diallyl barbituric); dicyandiamide; didial (ethyl morphine diallyl barbiturate); dysprosium oxide; olbon (cinnamoyl para oxyphenyl urea); erbium oxide; ethylene bromide; eukodal; europium oxide; furfurol; gadolinium oxide; glycol ethers; guaiacol carbonate (duotal); holmium oxide; hydroquinone; integrators (planimeter type); R. lead acetate; lead tetraethyl; lipoiodin; lutecium oxide; metaldehyde; methyl cyclohexanol methyl adipate; methyl sulphonal (diethylsulphonemethylethylmethane, trional); nickel hydroxide; papaverine; phenacetin (acetparaphenetidine); phenazone (antipyrine; phenyldimthylpyrazolone; analgesin; anodynine; dimethyl oxychinizin); phenetidine paraphytin; piperazine (diethylene-diamine; dispermin); planimeters; R. potassium chlorate; potassium ethylxanthogenate (potassum xanthogenate); potassium guaiacol sulphonate (thoicol); R. potassium hydroxide (R. potassium caustic; R. potassium hydrate); R. potassium permanganate; pyramidon-veronal; quinine ethyl-carbonate; radium compounds; resorcine (resorcinol); salol (phenyl salicylate); samarium oxide; styracol (guaiacol cinnamate); sulphonal; synthalin; terbium oxide; thulium oxide; urea (carbamide); vanadium-silica compounds specially prepared for use as catalysts for sulphuric acid manufacture; ytterbium oxide.

The Treasury Order will shortly be published by the Stationery Office.

AN IMPROVED METHOD OF RECOVERING MANGANESE FROM ITS ORE.

Electrically-heated furnaces, or induction furnaces, are well known. Improvements either in their design or in their application to the recovery of some metal are of considerable practical and scientific interest.

It appears that in the United States Dr. J. B. Friauf has succeeded in separating out pure manganese from its ore by the design and use of a special 'still,' for Dr. Friauf distils manganese from its ore in a crucible made of fused silica the high-temperature heating being effected by induced currents in the charge which are brought about by an alternating magnetic flux set up by a surrounding coil made hollow or tubular so that it can be cooled by a flow of water through the conductor conveying the alternating current. The vapour is conducted through a special chimney where it condenses. In this case the metal, manganese, is thus deposited in a metallic state, and of high purity. The details of this furnace and its operation are not at hand. The writer of this note has not had time to investigate the literature on the subject; but those interested will be able to follow the subject up from this brief account. F. H. L.

GAS THE ONLY FUEL FOR HEATING AMERICAN HOMES.

That within a relatively few years gas will be the only fuel used for heating the homes of America, was the prediction made by a speaker, a "captain of industry," at a recent conference of the American Gas Association.

"The great future for gas," he asserted, "is in the large-scale heating field. Not only is gas the best heating fuel for the home, but it is also the only fuel whose continuity of supply can be depended upon." Oil was not, he said, and never could be, so abundant that its use for heating houses would ever become general. The speaker stressed the importance of the movement to abate the smoke nuisance, declaring that the desire of citizens for "clean city skies" would also lead inevitably to the general adoption of gas heating.

"If" (comments the editor of the Co-partnership Journal of the South Metropolitan Gas Company in the current issue) "the speaker is indeed a true prophet, and not merely a transatlantic personification of Old Moore, our gas industry at home will have to look to its laurels."

Proceedings and Notices of Societies

THE INSTITUTE OF CHEMISTRY.

The first S. M. Gluckstein Memorial Lecture will be delivered by Dr. Leslie H. Lampitt at the Institute on Friday, 13th December, at 8 p.m., Professor Arthur Smithells, President of the Institute, in the chair.

Dr. Lampitt has chosen for his subject: "The Chemist and Commerce."

The late S. M. Gluckstein, a director of Messrs. J. Lyons & Co., Ltd., read before the London and South Eastern Counties Section in October, 1927, a paper entitled "Chemistry and Dividends," in which he gave an account of the development of the chemical staff and laboratories of his company illustrating the bearing of science, and particularly chemistry, on the management of a large industrial undertaking. He showed how the services of chemists had been appreciated by the directors, giving a frank expression of his views based on the experience gained over a period of eight years during which the laboratory staff of the company had been gradually increased to 72 chemists and assistants, now accommodated in the laboratories at Kensington opened this year, of which Mr. Gluckstein, who died on the 29th August, 1928, did not live to see the completion.

In memory of the director who had taken so great an interest in their work, the staff of the laboratory, of which Dr. Lampitt is the head, offered the Council of the Institute a sum of approximately £200 to administer this fund for the provision of an annual lecture, the purpose of which is to show the bearing of science on industry, particularly in various fields of chemical activity.

The lecture will be open to members of other societies and to the public.

THE GEOLOGICAL SOCIETY.

October 23.

Proceedings at the meeting held on October 23, Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the chair. The following communications were read:—

The Petalocrinus *Limestone Horizon at Woolihope (Herefordshire).* By ROY WOODHOUSE POCOCK, M.Sc., F.G.S.

Upper Llandovery sandstones surmounted by Woolhope Limestone beds form the core of the Silurian anticline of Woolhope. These two groups are separated by a thickness of some 20 feet of Transition Shales with thin bands of limestone. One of these limestone occurs in the Transition Beds about 5 feet from their summit, and is composed mainly of the remains of the crinoid *Petalocrinus*, which has been recorded from Sweden and North America, but has not hitherto been found in Britain.

The most striking peculiarity of the crinoid is the fusion of the arms into five solid arm-fans or petals, which radiate from the dorsal cup. The arm-fans are usually found detached in the lime-stone, throughout which they are profusely scattered.

The Carnmenellis Granite: Its Petrology, Metamorphism, and Tectonics. By P. K. GHOSH, Ph.D., D.I.C.

The paper dealt with the petrology and tectonics of the Carnmenellis granite-mass and its metamorphic aureole. The granite, which occupies an area of some 50 square miles between Falmouth and Camborne (Cornwall), was divided by the Geological Survey into (1) an earlier coarse variety and (2) a later fine variety. In this paper the coarse granite of the Survey has been subdivided into three types, which, from evidence in the field as well as in tht laboratory, prove to be three distinct intrusions. The petrological characters of the granites and their differentiates are described and discussed, while twelve especially made analyses illustrate the composition of the rocks and minerals of the granitic seres. Twelve analyses have also been made of the associated metamorphic rocks. These latter consist of "greenstones," slates, and schists of various types, as well as inclusions of country-rock within the granite. Special attention has been paid to the chemical nature of the alteration-products.

Historic Changes of Level in the Delta of the Rhone. By RICHARD DIXON OLDHAM, F.R.S., F.G.S.

The history of the Rhone delta may be summarised:

At the opening of the Pleistocene Period the whole area, together with large tracts surrounding it, was covered by a deposit of gravel and well-rounded boulders, over which the Rhone and its tributaries wandered.

A period of subsidence followed, the gradient and the speed of current were diminished, and an alluvial delta built up, which was at least as extensive as that of the present day. Throughout both stages marine shells, of species still living, are found, and also beds of peat, the latter having been formed above, the former below sea-level.

A period of uplift then set in, and the

level to which it had sunk, the deposits laid down were exposed to denudation, and an undulating surface of erosion was developed. The date of this uplift cannot be defined in centuries, but it must have been long prehistoric in date.

Finally came another period of subsidence, which was not regular and continuous, but took place at intervals, alternating with others, of longer duration, during which no material change took place. One of these periods of subsidence was earlier than the establishment of Roman dominion in Provence, and, although there is no direct evidence by which it can be dated, analogy with later events suggests that it probably took place between the years 1000 and 1500 B.C. The next change took place in the course of the 8th and 9th centuries; it amounted to about 5 metres of vertical displacement.

Prof. E. W. Skeats, D.Sc., F.G.S., exhibited a very perfect australite from Mount Cameron (Tasmania). The specimen showed a central circular button, with a thin outer rim of irregular outline perfectly preserved. Lantern-slides of other australites, billitonites, moldavites, and "Darwin glass" were also shown, and a brief review of theories of the origin of tektites was given.

November 6.

Fossil Insects of the South Wales Coal-field. By HERBERT BOLTON, D.Sc., F.R.S.E. F.G.S.

The author describes a collection of fossil wings from the South Wales Coal Measures numbering nineteen specimens.

On the Glaciation of Clun Forest, Radnor Forest, and some Adjoining Districts. By MAJOR ARTHUR RICHARD DWERRYHOUSE, T.D., D.Sc., M.R.I.A., F.G.S., AND A. AUSTIN MILLER, M.Sc.

The district described comprises the county of Radnor and parts of Montgomeryshire, Shropshire, Brecknockshire, Herefordshire, and Worcestershire, and is some 1000 miles in area.

Dr. H. Bolton exhibited specimens and lantern-slides in illustration of his paper, and lantern-slides were exhibited by Major A. R. Dwerryhouse and Mr. A. A. Miller in illustration of their paper, together with a model of a contoured map of the area.

The Geology of the Country between Nant Peris and Nant Ffrancon (Snowdonia). By DAVID WILLIAMS, M.Sc., Ph.D., B.E., D.I.C., F.G.S.

The Upper Estuarine Series of Northamptonshire and Northern Oxfordshire. By BEEBY THOMPSON, F.G.S., F.C.S.

J. B. TYRRELL FUND.

The second Award from this Fund will be made in February, 1930. The amount at present available is about £100, and applications are now invited from British and Irish geologists who propose to visit the Dominion of Canada for the purpose of study or research, and who require assistance in the payment of the necessary travelling and living expenses. Applications, to be addressed to the Secretary, will be received not later than January 15, 1930, and must be accompanied by a statement of the programme intended and of the qualifications of the applicant.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated.

Formation of Itaconic Acid and Mannite by a New Filamentous Fungus. By KONO KINOSHITA.

Camphor Groups. Supplements to Report I. By SEIICHI YAMADA.

Camphor Groups. II. Oxidative Linking of Thebainone. By KAKUJI GOTO.

Dielectric Constants and Anomalous Dispersions of Electrolytic and Colloidal Solutions. I. By SAN-ICHIRO MIZUSHIMA AND SHIKAZO NISHIFUKU.

Proteins. X. Does the Glutenine Differ in Character in Different Forms of Wheat? By KINSUKE KONO AND TSUNETOMO HAYASHI.

MATTER AND SPACE. EQUILIBRIUM.

An "Ignorant Student" writes :—

Presumably—

Matter is in a state of unstable equilibrium, and therefore in a state of vibratia; and the greater the density the greater the frequency of the vibrations; and so also the greater the compression and Gravity, and *apparent* stability.

But the only condition really approaching equilibrium is in the Æther where Matter is very rare, and tension prevails rather than density.

And it is only in the ultimate (which is also the primary) state of the Æther, in which state there are Electrons only, that there is any real approximation to complete equilibrium.

In that state of the Æther the Electrons repelling each other separate until they are at equal distances from one another and come to rest—and then (until they are again disturbed) there is more or less perfect and stable equilibrium and inertia.

Is this not so?

BRITISH TAR OR FOREIGN BITUMEN FOR OUR ROADS.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—I wish to correct certain unjustifiable and misleading statements which have recently appeared in the Press alleging that bitumen is as British a product as tar, and that those primarily responsible for the campaign in support of British tar are themselves importing foreign stone for use on the roads.

On the first point it should be noted that during the first ten months of this year over 100,000 tons of refined bitumen were imported into this country, quite apart from the bitumen which was produced here from imported crude petroleum.

On the other hand, British tar is British in origin and manufacture; it is produced in British works from British coal. Bitumen, by contrast, is of foreign origin. That is beyond dispute. At best, for a proportion of the bitumen used here, the raw material —crude petroleum—is brought from abroad to be refined in this country, while at worst, refined bitumen is imported as a manufactured article, in the production of which no penny of wages is paid to British workpeople.

As for the second point, the use of British tar on our roads has recently been advocated by Members of Parliament, surveyors, coke-oven managers and others, and one does not readily identify any of those whose letters and articles have appeared in the Press with the importation of foreign stone at any time, for many years past.

To take two instances, Sir Henry Page Croft, M.P., and Mr. Will Thorne, M.P., representing, respectively, Conservative and Labour points of view, have advanced the direct plea that British tar should be used on British roads in the interests of the great organised industries—gas, coke, steel and coal—which depend, each in a greater or less degree, on a home market for tar. Such support for British tar can scarcely be brushed on one side by a casual reference to those who import foreign stone.

Yours faithfully,
ARTHUR E. COLLINS.

10, Cambridge Road,
Colchester.
23 November, 1929.

NEW FUELS FOR SHIPS.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir, the mere digging up of coal in order that it may be shovelled straight into fires and furnaces is a crude and wasteful proceeding, which will have to be abolished if ever the coal industry is to get out of its present state of penury. In fact, it is being abolished by fuel consumers themselves who, whether in industry or the home, are daily burning less raw coal, and turning to cleaner and more efficient heating substitutes.

At sea, for example, as the latest statistics published in Lloyd's register show, oil fuel is rapidly replacing bunker coal in all classes of the mercantile marine, and, at the present rate of change, the day is not far distant when the last stoker will have thrown the last shovelful of raw coal into the furnace of a British tramp.

Oil is definitely superior to coal—burned as coal. It is clean, easy to handle and economical to use. For maritime purposes it has coal beaten. What this means to the coal industry is vividly revealed in the fact that the conversion of an average steamer from coal to oil throws twenty British miners out of work for ever.

Fortunately, there are ways and means of meeting this problem of ships' fuel to the lasting advantage of the British coal industry.

First of all, there is pulverised fuel. Already many successful voyages have been made by tramp steamers using this new system, and it is announced that, after extensive trials, a shipping company has decided to have built two new cargo steamers driven by engines developing 7,000 horse-power and designed exclusively for the use of pulverised fuel. This is an advance of the greatest significance to the coal industry, for if pulverised fuel—cheaper than oil as it is—wins back the general run of cargo boats, then coal in this new form will have secured a new and very extensive marine market.

Excellent as pulverised fuel promises to be for tramp steamers, it is wholly unsuitable for warships and large liners. It has to be pulverised on board from day to day as required, and thus it leaves untouched the problem of bunkering and handling the bulk coal. The superiority of oil for the Navy is revealed in the latest returns, which show that the total coal requirements of the Admiralty to-day are 300,000 tons per annum against 2,000,000 tons twenty years ago. The same measure of superiority rests with oil for passenger liners.

Even here, however, the British coal industry has an excellent prospect of coming into its own by way of fuel oils extracted from coal. The Navy and our passenger liners must have oil, but it is going to be

home-produced oil, if full advantage is taken of the latest scientific methods of producing oil from British coal. Already these fuel oils are being obtained in the required quality, by means of the coalite carbonisation process, and to-day they are actually being distilled from Yorkshire coal.

By the active development of this new method of modernising coal, we are now offered the opportunity of recapturing, as a permanent market for British products, both the Navy and the whole range of the mercantile marine, which are at present buyers of imported oils. Will the coal industry seize the opportunity?

Yours faithfully,
COLIN BUIST.

1, South Eaton Place,
London, S.W.1.
26 November, 1929.

NOTICES OF BOOKS.

Simple Research Problems in Chemistry. By F. SHERWOOD TAYLOR, M.A., B.Sc., Pp. VII + 100. London: W. Heinemann, Ltd., 99, Gt. Russell Street, W.C.1. 1929. Price 4s.

This book contains over a hundred and fifty practical problems to be solved by the post-matriculation student of chemistry. Each set of problems is preceded by a discussion of the methods available for solution, while the physical chemistry involved is also briefly but adequately explained. The material for the problems is in most cases derived from advanced books of reference and from original papers. Since no work of reference need be consulted in solving the problems, the book is self-contained, and due care has been taken that the materials for the majority of the problems shall be found in almost all laboratories.

The book is valuable as a means of providing problems to which the student does not already know the answer, since the exercise of the facilities needed for chemical research cannot fail to be of great value to those pupils who show some intelligent interest in their work.

In the Preface the author says:

"There is a marked tendency for a student to obtain a first-class degree without finding out anything at all, except the results of a few practical exercises carefully arranged to 'come out.' This is not as it should be, and it may be that a proportion of research introduced into the school and university courses may at once train students to a more scientific point of view, and, perhaps, give more opportunity to men who have imagination as well as memory. The problems contained in this book assume the ability of the student to recognise most of the metallic salts and simple substances by chemical tests."

PUBLICATIONS RECEIVED.

U. S. BUREAU OF STANDARDS.

Rope, Manila, F.S. 61b. Price 5 cents.

Towers. F.S. 442a. Price 5 cents.

Sheeting, Cotton, Unbleached. F.S. 801a. Price 5 cents.

U. S. GEOLOGICAL SURVEY.

Moraines and Shore Lines of the Lake Superior Region. By Frank Leverett. Professional Paper 154-A. Price 50 cents.

Ground Water in Yellowstone and Treasure Counties, Montana. By G. M. Hall and C. S. Howard (Water Supply Paper 599.) Price 25 cents.

Geology and Ground Water Resources of Central and Southern Rosebud County, Montana. By B. Coleman Renick. (Water Supply Paper 600.) Price 35 cents.

Geology of the McCalls Ferry-Quarryville District, Pennsylvania. By E. Bliss Knopf, and A. I. Jonas. Bulletin 799. Price 85 cents.

Formulas and Tables for the Construction of Polyconic Projections. By C. H. Birdseye. Bulletin 809. Price 25 cents.

Geology of the De Queen and Caddo Gap Quadrangles, Arkansas. By H. D. Miser and A. H. Purdue. Bulletin 808. Price 75 cents.

The Mount Spurr Region, Alaska. By S. R. Capps. Bulletin 810-b.

Recent Mining Developments in the Creede District, Colorado. By E. S. Larsen. Bulletin 811-b. Price 10 cents.

THE INTERNATIONAL YEARBOOK OF AGRICULTURAL STATISTICS.

The International Institute of Agriculture at Rome has just recently published the 1929 edition of the International Yearbook of Agricultural Statistics.

This volume of about 600 pages is the result of the most extensive and detailed inquiry which has up to the present been carried out in the domain of international agricultural statistics and constitutes a work of the greatest importance to all those who are interested in questions having a direct or indirect relation to production and commerce of agricultural products.

AN INTERFERENCE METHOD FOR THE DETERMINATION OF AXIAL AND OBLIQUE ABERRATIONS.

By A. H. Bennett.

(*Bureau of Standards Research Journal.*)

An interference method for the determination of the axial and oblique monochromatic aberrations of a lens system is described. Equations necessary in the design of the apparatus, and for the computation of the results are given. The simplicity of the apparatus, especially the use of but one auxiliary reflecting surface, lessens the probability of large instrumental errors. The abberations of three astronomical objectives are investigated, and the results are expressed in the form of phase coutours.

Summary and Conclusons.

A method for measuring the axial and oblique aberrations of a lens system is described. This method, which is based on directly in terms of the difference of phase interference, determines the aberrations *directly in terms of the difference of phase* between the various positions of the emergent wave front iu passing through any point on the axis or chief ray. By a simple computation such a point may be selected which will produce minimum phase residuals, representing the point of best imagery. The expression of the aberrations directly in terms of phase differences enables one to compare them with the Rayleigh tolerance.

The method requires only simple apparatus, but its accuracy is of the order of the geometric method of Hartmann.

Examples of the application of the method to the measurement of the monochromatic aberrations of three telescope objectives are presented. These examples show the performance of the lens as compared with the Rayleigh tolerance. The characteristic effects of the axial aberration; that is, spherical aberration; and also of the oblique aberrations, coma, and astigmatism; on the emergent wave front are illustrated.

The procedure is an accurate method, utilising simple apparatus, for the determination of the small amounts of aberration present in astronomical objectives. It should be pointed out that even in a well-designed astronomical objective the " technical " aberrations, arising from lack of homogeneity of the glass and from errors in workmanship, are always present to some extent. The irregularities of the contours illustrated show these effects very pronouncedly. Hence, in order to correctly judge the performance of such a lens care should be taken to explore a sufficient number of points on the emergent wave surface so that reliable information can be gained concerning local irregularities, as well as the regular aberrations.

ROYAL TECHNICAL COLLEGE, GLASGOW.

From the *Annual Report* of the Royal Technical College, Glasgow (1929), it os seen that this important centre of scientific and technical education has fully maintained its high standard during the past session. The number of students enrolled is slightly higher than in the previous session and there has also been an increase in the number of examination successes and in the volume of original research work emanating from the chemistry section.

" CLEAN AIR."

The National Smoke Abatement Society has decided to publish a quarterly (price 1s. or 2s. 6d. per annum), and Vol. I. No. 1 has just appeared. It contains matter dealing with domestic and industrial heating, the use and development of electricity and of gas in industry. In the editorial commentary reference is made to the very large number of journals and periodicals now printed but none are " interested in " clean air; only a few occasionally allude to smoke abatement.

The subject is one which interests all, scientific workers and chemists especially, and it is to be hoped that success will crown the efforts of those who are engaged in pointing the way to the removal of a costly and wastful nuisance.

Forthcoming Events.

THE INSTITUTE OF CHEMISTRY.

Dr. Leslie H. Lampitt, F.I.C., will deliver the first S. M. Gluckstein Memorial Lecture, at the Institute, 30, Russell Square, London, W.C.1., on Friday, 13 December, 1929, at 8 p.m. The subject will be " The Chemist and Commerce." Prof. Arthur Smithells, C.M.G., D.Sc., F.R.S., President of the Institute, in the chair.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Manchester Section.

Friday, December 13, at Milton Hall, Deansgate. Members' Night. " Fastness to Light." By Dr. Stern, B.Sc.,

" Some Aspects of Colour Testing." By C. D. O. Winslade, B.Sc.

THE SOCIETY OF DYERS AND COLOURISTS.

Manchester Section.

December 13, at Milton hall, Deansgate. " Patent Law in Relation to the Dyestuffs Industry." By C. Hollins, B.Sc., A.I.C.

(Joint meeting with Chemical Section of Manchester Literary and Philosophical Society.)

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Wednesday, December 11, at 8 p.m.—(Ordinary Meeting.) Major Charles Wheeler, O.B.E., M.I.A.E., formerly Chief Automobile Engineer of the General Post Office : " Overheads and other Factors Influencing Road Transport Costs, from an Engineer's Viewpoint." John Maughfling, C.A., will preside.

THE OPTICAL SOCIETY.

A meeting of the Optical Society will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7., on Thursday, December 12, at 7.30 p.m.

The following paper will be presented and discussed :— " The Insensitivity and Personal Equation Errors of Optical Settings." By J. Guild, A.R.C.Sc., F.Inst.P., of the National Physical Laboratory.

Exhibits and Demonstrations.—(1) Adam Hilger, Ltd. : " Cylindrical Mirror corrected to give freedom from aberration in the formation of an image of a distant line when the angle of incidence is 45°." A description will be given by Mr. Underhill. (2) Mr. Clifford Brown, Wigmore Street : " Duo Chrome Sight Test." (3) C. W. Dixey & Son, Welbeck Street : "The Maddox Cheiroscope."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

34,142.—Bodrero, B. — Manufacture of neutral superphosphate. November 8.

33,584.—Elektrochemische Werke München Akt.-Ges.—Storage, etc., of hydrogen peroxide. November 5.

33,831.—Elkington, H. D. (Naamlooze Vennootschap de Bataafsche petroleum Maatschappij). — Manufacture of alcohols. November 6.

33,738.—Dryden, W. — Mechanically-operated pestles and mortars. Nov. 6.

34,148.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of glycollic acid esters. November 8.

Specifications Published.

321,161.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges. — Production of highly halogenated derivatives of pyranthrone.

295,990.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of condensation products of naphthalene and naphthalene derivatives.

321,241.—Johnson, J. C. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture and production of acetaldehyde and acetic acid.

Abstract Published.

319,433.—Acetic acid. — Rowell, S. W., Norton Hall, The Green, Norton-on-Tees, and Imperial Chemical Industries, Ltd., Millbank, London.

Acetaldehyde in a 10-25 per cent. solution in acetic acid is oxidised to acetic acid in a continuous process by means of air or oxygen in extremely finely divided form, such as is obtained by passing the gas through a porous plate or similar device for

producing minute bubbles. The process may be carried out in a tower in which the solution of acetaldehyde rests on a porous plate through which the oxidising gas is forced from below. The solution may be obtained by mixing acetaldehyde in liquid or in vapour form with acetic acid in the upper part of the tower, or by treating it with acetic acid in countercurrent in a separate tower. The reaction may be conducted at atmospheric or higher pressure, and the oxidation tower may be provided with heating or cooling coils. The gases escaping from the oxidation tower may be freed from acetaldehyde vapour by washing with acetic acid, the washings being added to the liquid undergoing oxidation.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His

LUITPOLD.

506,707.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — August Karreth, trading as Luitpoldwerk Chemisch-Pharmazeutische Fabrik Luitpold-Werk, Zielstattstrasse 9, Munchen 25, Bavaria, Germany. November 13.

MURLAFORM.

506,783.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—Murphy & Son, Ltd., Wheathampstead House, Wheathampstead, Hertfordshire. November 13.

CALPRUFE.

505,871.—A chemical substance in class 1 for treating plaster walls before painting.—Callow Rock Lime Co., Ltd., Shipham, Winscombe, Somerset. November 13.

ABRUNDUM.

505,102.—Carbide of silicon for use in manufactures. — Abrafract, Ltd., Beulah Road, Owlerton, Sheffield. November 13.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,

The Chemical News,

Offices : Merton House, Salisbury Square.

London, E.C.4.

TECHNICAL TRANSLATIONS.

Translations from and into French or German undertaken by a competent linguist. Charges moderate. Enquiries invited.—J. L. c/o *Chemical News.*

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

URGENTLY WANTED

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Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

CHEMICAL NEWS:

No. 3123, Vol. 120; dated April 16, 1920. Good price, and postage, paid.

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THE CHEMICAL NEWS

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THE REMOVAL OF INTERFERING ACIDS PRIOR TO SYSTEMATIC METALLIC ANALYSIS.

By L. J. CURTMAN AND M. WIGLER.
(*College of the City of New York.*)

REDUCTION OF ARSENATE AND CHROMATE.

(*Continued from page 355.*)

The only acids not yet provided for are arsenate and chromate. Sulphurous acid was selected as the most convenient reducing agent to remove these acids. 500 mg. of CrO_4 as K_2CrO_4 were readily reduced by adding 20 cc. 1.8 N H_2SO_3 and then boiling the solution until the excess of SO_2 was driven off. Under the same conditions 500 mg. AsO_4 were not completely reduced even when a large amount of H_2SO_3 was used. By employing a great excess (50 cc. 1.8 N H_2SO_3), heating the mixture just below the boiling point for 25 minutes, and then boiling the solution free of SO_2, practically all the arsenate may be reduced.

Thus far, all the acids, with the exceptions noted above, have been successfully eliminated either by hot concentrated H_2SO_4, by a mixture of H_2SO_4 and HNO_3, or by H_2SO_3. Evidently, to remove acids in any combination, a procedure must employ some arrangement of these reagents, the sulphurous acid being applied after the HNO_3 treatment. Against such a method, the following objections may be raised :—

1. During the fuming of H_2SO_4 certain metals may be lost by volatilisation.

2. There is danger in treating an unknown substance which may contain chlorate with concentrated sulphuric acid and heating the mixture.

3. The large amounts of salt obtained by the neutralisation of the H_2SO_4 may make it difficult to adjust to the proper acidity and otherwise interfere with precipitations.

4. Such a procedure would yield an insoluble residue of the sulphates of lead and the alkaline earth metals, as well as certain dehydrated salts.

5. Where Cr, Fe, and Co are present in the acid radicals, special tests must be made for cathodic Fe, Cr, and Co.

These objections will now be considered in greater detail.

The metals which distil off when a sulphuric acid solution of their salts is fumed are trivalent arsenic and mercury. While arsenates are not volatilised, arsenites are more or less completely removed, the amount depending on the duration of the fuming. In any case, this loss is of no practical significance since arsenic is detected in the acid anaylsis. The loss of mercury, however, is of vital concern. Enough of this metal must remain to furnish a positive test in the systematic metallic analysis. The following table gives the results of fuming for two minutes various amounts of Hg as $HgCl_2$[3] with 18 cc. 6N H_2SO_4 :

[3] The solution of $HgCl_2$ used in these experiments contained also 1 gram of NaCl per litre.

mg Hg taken		Approximate amount of Hg found after fuming
500	... ...	50
100	... ...	30
50	... ...	10
25	... ...	9
15	... ...	8
10	... ...	8

These results show that in spite of the loss of the greater part of the mercury enough remains to give a positive test in the systematic metallic analysis.

The second objection, that concentrated H_2SO_4 may react violently with chlorates, has been obviated by using 6N H_2SO_4. Acid of this concentration may be added to solid $KClO_3$ and the mixture heated to fuming without the crackling which accompanies the use of more concentrated acid. Another factor making for safety is the use of a casserole whose large area permits the ready removal of the gases generated.

The third objection has been found invalid. The $(NH_4)_2SO_4$ formed by neutralising the H_2SO_4 does not interfere with the adjustment of the acidity preliminary to the precipitation of the Group II metals with H_2S. Moreover, in the usual volumes employed in the systematic analysis, this salt will crystallise out only when concentrating the solution for the Mg test. At this point the $(NH_4)_2SO_4$ may be filtered off.

The fourth objection is one which arises so frequently that efficient procedures have been devised for the analysis of the H_2SO_4 residue. According to Noyes' Qualitative Chemical Analysis, 9th Ed., p. 50, this residue may consist of the sulphates of Ba, Sr, Pb, nearly all the Ca, Cr (in the form of the anhydrous sulphate), basic bismuth sulphate and Sb_2O_3. Among the undecomposed substances may be AgCl, Al_2O_3, $FeCrO_4$, SnO_2, anhydrous silicates, graphite, and carborundum. To these we may add Ag_2SO_4, $Fe_2(SO_4)_3$, and any other moderately soluble sulphate present in large amounts. Such a residue is best analysed by boiling with 3N Na_2CO_3 solution, filtering, dissolving the washed residue in hot dilute HCl, and testing the resulting solution for Ba, Sr, Pb, Bi, Sb, Cr, Ca and Fe. The residue which does not dissolve in the dilute HCl must be fused with alkali carbonate and nitrate.

The fifth of the possible disadvantages enumerated previously is that special tests are required for those metals (cations) resulting from the action of H_2SO_4, HNO_3 or H_2SO_3 on certain interfering acids. For example, a separate test must be made for Cr^{+++} if $CrO_4^{=}$ is found. For a similar reason, it will be necessary to make a special test for Fe and Co when their respective complex cyanides are detected in the acid analysis. The solution employed for these special tests is obtained by dissolving in HCl the well-washed residue left on boiling the original substance with 3N Na_2CO_3.

Systematic Procedure for the Elimination of Interfering Acids.

Based upon the results of the above experiments the following procedure was devised : To a one gram sample of the unknown substance (1) in the casserole we add 18 cc. 6N H_2SO_4 and 10 cc. 15N HNO_3 (2). Boil the mixture, with frequent stirring, until fumes of SO_3 are given off. Allow to cool. Add 10 cc. more of 15N HNO_3 and evaporate down to SO_3 fumes, repeating the additions of and evaporating with HNO_3 until a straw-coloured solution is obtained (3). Fume for one minute. Cool. Add 50 cc. H_2SO_3 (4) (strength approximately 1.8N) and heat just below the boiling point for 25 minutes. Boil the solution down to fuming and fume strongly for 2-3 minutes. Cool. Wash the H_2SO_4 and residue into 50 cc. of water contained in a 250 cc. beaker (5). Boil gently (6) for 5-10 minutes keeping the volume constant. Filter. Analyse (7) the filtrate for all metals except Pb, Ba and Sr. Treat the residue with 25 cc. Na_2CO_3 and boil the mixture gently for 10 minutes. Filter and wash the residue carefully. Treat it with 15 cc. hot 3N HCl, filtering if necessary (8), and test the solution for Pb, Fe, Sb, Bi, Cr, Ca, Sr, and Ba.

Notes on the Procedure.

(1) It is assumed that the acid radicals have already been tested for. If fluorides have been found, slight amounts of Al and Fe will be introduced from the casserole. The tests obtained for these metals in the systematic analysis should therefore be compared with those obtained with small, known amounts. It is better, however, to use a platinum dish if fluorides are present.

(2) If organic matter is absent omit the HNO_3 treatment.

(3) The straw-colour resulting from the destruction of organic matter may be obscured or modified by the presence of other substances. Thus in the presence of copper a green solution (yellow + blue) results.

(4) If AsO_4 and CrO_4 are both absent omit the treatment with H_2SO_3 and merely fume strongly for 2 minutes after the last addition of HNO_3. However, if arsenite and organic matter are both present, H_2SO_3 must be employed.

(5) On diluting the H_2SO_4, a change of colour may sometimes result. A blue colouration indicates incomplete destruction of ferro- and ferricyanide. In such cases, re-heat the mixture and fume strongly for an additional two minutes, agitating the mixture so that all the residue comes into contact with the hot acid.

(6) The solution is boiled at this point to dissolve as much as possible of the slowly dissolving sulphate.

(7) In the metallic analysis the only metal of Group 1 likely to be present is Ag, for Hg is rendered divalent by fuming with H_2SO_4 while all the Pb is precipitated as $PbSO_4$. Therefore, add a drop of dilute HCl to the H_2SO_4 solution of the metals and if no cloudiness occurs the solution may be neutralised and the acidity adjusted for the precipitation of metals of Group II. If a precipitate does occur, filter it off and confirm the presence of Ag.

(8) The residue at this point may consist of untransposed sulphates or substances not decomposed by the H_2SO_4 treatment. If the residue is large, it should be fused in a nickel crucible with Na_2CO_3 to which a little $NaNO_3$ is added.

Test Analyses.

To test the efficiency of this procedure, test analyses were made : 15 mg. each of Ag, Cu, Fe, Al, Ba, and Mg were combined with 100 mg. of the interfering acids I, Br, F, C_2O_4, C_2O_4, $C_4H_4O_6$, $Fe(CN)_6$ III, $Fe(CN)_6$ IV, AsO_4, CrO_4 SCN, S_2O_3 ClO_3. No difficulty in identifying the different elements was encountered.

Summary.

1. It has been shown that the acid analysis should precede the examination for metals in systematic qualitative analysis, thus reversing the conventional order.

2. The acids which interfere with the metallic analysis have been subjected to an experimental study with the object of devising a method for their removal.

3. A systematic procedure has been proposed for the elimination of all the interfering acids.

4. A series of test-analyses show the method to be trustworthy.

New York City, N.Y.

ELEMENTS IN THE SUN.

(Third Note.)

In the *Chemical News* of October 18, 1929, *139*, 244), the writer gave a brief abstract of a long paper by H. N. Russell which appeared in the July issue of the *Astrophysical Journal* (page 11).

In further studying this paper the following features were noticed, which are reproduced here.

Referring to the elements in the sun's atmosphere " The case of most of the heavier elements is quite different. For three of them—Os, Bi, and Ra—persistent lines lie in accessible regions and are definitely absent from the solar spectrum. Though Ra is probably easily ionised, the persistent lines of Ra+ are also absent. There seems to be no escape, therefore, from the conclusion that these elements are present in the sun's atmosphere in negligible quantities, if at all."

Furthermore, on page 59 Russell says : " Two features of the distribution are conspicuous. First, is the general downward trend toward the right, corresponding to a diminution in the abundance with increasing atomic number. The fact is familiar; its interpretation, less certain. The faintness of the lines of the heavy elements in the sun is commonly attributed to the tendency of the heavy atom to diffuse downward, below the photosphere. If this were the main explanation we should expect the heavy elements following Ba to be considerably less abundant than those which succeed Sr; but the figure shows that this is not the case and suggests a relatively rapid fall for the lighter elements from H about as far as Zr, and a very slow decrease for the heavier ones.

" Stirring of the solar atmosphere by current and other forms of turbulence favours a uniform mixture. This process occurs on an enormous scale in sun-spots, where the material must ascend from a considerable depth. The fact that the lines La+ and other heavy elements, which are completely ionised even in the spots, are not perceptibly strengthened in the spot spectrum indicates that the difference in composition is small at the depth from which the ascending vortex comes. It does not appear necessary, therefore, to assume that downward diffusion depletes the sun's atmosphere of the heavier elements, though the possibility of such an influence remains."

On page 61 Russell says, referring to the *even* atomic-number elements being more abundant as a rule in the sun, that Na and K " are real exceptions, for if Ne and Ar, which precede them, were anything like as

abundant, we might expect them to show in their flash spectrum." See in this connection Loring, *Chemical News*, 1929, *139*, 1.

Also on the same page this author says: "The abundance of an element is probably a function of yet unknown properties of the structure of the atomic nucleus . . . The very low abundance for Li and Be suggests that nuclei containing so few component parts may be hard to keep together." See Second Note: *Chemical News*, 1929, *139*, 325. Particularly the statements about helium.

This is all of interest, as Sir James Jeans has suggested that there may be elements heavier than uranium of atomic number 92 in the centre of stars, as the following quotation from Jeans' ASTRONOMY AND COSMOGONY (1928), page 130, shows:—"Thus we must suppose that the atoms in the outer layers of the sun, from which the earth was formed, do not constitute a fair sample of the sun as a whole. This supposition can hardly be considered unreasonable, any more than the supposition that the earth's atmosphere is not a fair sample of the earth as a whole. Whatever mixture of elements may constitute the sun, the heavier elements are likely to sink to its far interior (see § 87, p. 91 above. Rosseland—*M.N.*, 1924, *84*, 722—claimed to have shown the contrary, but I believe his discussion was based on erroneous mathematical analysis —*M.N.*, 1926, 86, 561), so that the atoms in its outer layers are selected for their light atomic weight. If for simplicity we regard the sun as containing only two kinds of atoms—light elements which rise to its surface, and heavy elements which sink into its far interior—then the light elements, being similar to those found on earth, have practically no capacity for generating energy, so that the sun's generation of energy must originate in the heavy elements which reside in its interior regions." See in this connection Loring, *Chemical News*, 1929, *139*, 321. In Part II of this communication the writer hopes to show some further considerations both for and against the ideas contained in Part I cited above.

There is another way of looking at this problem that seems to offer two sorts of views as may be judged from the above extracts.

In H. T. Flint's WAVE MECHANICS (1929) pages 104, 105, the *principle of minimum proper time* is introduced (see references in this book) that is of interest here as developed by Flint. In this case there is an interval that is $2\pi r/v$, where r is the radius of the orbit and v is the velocity in the orbit. The equation of motion is $mv^2/r = Ne^2/r$, when $m = m_0/(1-\beta^2)^{\frac{1}{2}}$, Bohr's momentum being $mvr = h/2\pi$. $\beta = c/v$.

Consequently $2\pi r/v = (h/m_0c^2)(1-\beta^2)^{\frac{1}{2}}/\beta^2$, which must not come out less than—

$(h/m_0c^2)(1/(1-\beta^2)^{\frac{1}{2}}$.

This leads to an orbital limit in velocity since $\beta^2 \ngtr \frac{1}{2}$, the velocity cannot exceed $1/\sqrt{2}$ times c.

From this $v = 2\pi Ne^2/h$, whence

$2\pi Ne^2/h \ngtr (1/\sqrt{2})c$, or $N \ngtr hc/2\sqrt{2}\pi e^2$,

"which gives the highest nuclear order with *an electron in the inner nucleus*; thus the number of atoms constructed according to the Rutherford model is limited. If we work out the value of the quantity on the right-hand side we obtain approximately 97, the number being a little over 97, so that we expect the number to be limited to 97."

The symbols are those commonly used. The orbit is taken as circular in this case. It may be of interest to note that using values for the constants as published in these columns by the present writer (see Physical Constants) the limiting number comes out at 96.97.*

The above mathematical argument, if it may be so called, is not, however, conclusive, and at best some slight corrections may have to be made which may easily bring the number to 93 or 94. On the other hand, if there are atoms having atomic numbers above the hypothetical limiting value, especially atoms or nuclei in the centre of stars, then they would seem to involve a modified nuclear structure as Flint has pointed out in his book here consulted. In stellar depths new conditions may give rise to sorts of atoms or nuclei not found in the outer parts of stars or upon the earth.

It is all very interesting, and it shows how by experiment, study, and mathematical analysis the secrets of nature are being probed to their very depths, and some of this is the *science of matter in its last analysis*.

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* In my calculation the following values were used:—

$h = 6.5567 \times 10^{-27}$

$c = 2.99796 \times 10^{10}$

$e = 4.7761 \times 10^{-10}$

$\pi = 3.141592$

$\sqrt{2} = 1.41422$

Referring to the equations above, it should be noted that I have arranged them so that they have been set up by machine composition, a practice that should be universally adopted when the equations are such as to allow of straight-line setting.

F. H. LORING.

TWO ISOMERIC CRYSTALLINE COMPOUNDS OF d-MANNOSE WITH CALCIUM CHLORIDE.

By J. K. DALE.

(*U. S. Bureau of Standards.*)

A crystalline double compound of mannose and calcium chloride having the formula $C_{16}H_{12}O_6.CaCl_2.4H_2O$ has been prepared. The compound showed an extremely rapid initial rate of mutarotation from about $[a]D = -30$ to a positive maximum followed by a slow decrease to a constant value. The sugar constituent of this compound is a new form of mannose, and application of Hudson's rule indicates that it is the beta form corresponding in ring structure with a-mannose of $[a]D = +30$. A second isomer having the formula $C_6H_{12}O_6.CaCl_2.2H_2O$ was obtained by evaporating an alcoholic solution of the above compound on a water bath. Its initial and final specific rotation and course of mutarotation indicate that it is a double compound of the well-known β-mannose of $[a]D = -17$ with calcium chloride. The second compound, but not the first, could be acetylated to give a good yield of β-mannose pentaacetate.

MINERS' WELFARE NATIONAL SCHOLARSHIP SCHEME.

The Trustees of the Miners' Welfare National Scholarship Scheme invite applications for a limited number of University Scholarships under the scheme.

Candidates must be either workers in or about coal mines in Great Britain, or sons or daughters of such workers, and must be not less than 17 years of age on 25 January, 1930.

Forms of application and full particulars may be obtained from the Secretary, Miner's Welfare National Scholarship Scheme, Mines Department, Dean Stanley Street, London, S.W.1. Applicants for forms must state whether they apply as workers in or about mines or as children of such workers, as the form is different in each case. Persons who come within both categories should apply as miners.

Intending candidates are advised to write for application forms as early as possible,

ALBERTA SUGAR BEET INDUSTRY.

The production of sugar beets in southern Alberta for the 1929 season is likely to be about 20,000 tons in excess of the record for any other year since the industry was begun. The cultivation of sugar beets in southern Alberta was organised by the Canadian Sugar Factories, Ltd., five years ago when the Utah-Idaho Sugar Company, a large American beet sugar manufacturing concern, entered western Canada and organised a Canadian subsidiary which erected a refinery at Raymond.

In a statement made recently, Mr. T. George Wood, manager of the Raymond factory, referred to the high content of the beets grown in 1929, declaring that the Alberta-grown crop was superior to that of any unit in the Utah-Idaho chain of 16 factory areas. In emphasising the opportunity for expansion in Alberta, Mr. Wood pointed out that beet production in the State of Colorado reached a total of about 2,000,000 tons annually, the figure for Nebraska being about 1,000,000 tons and the crop in Montana about 500,000 tons annually.

Promising results have been obtained from the use of the superphosphate fertiliser produced at the Trail Smelter of the Consolidated Mining and Smelting Company of Canada, Limited, one test plot having produced 16 tons of beet per acre as against 13 tons per acre from an untreated plot. The Lethbridge Northern Irrigation District produced 50 per cent. of the beets grown in 1929, and is characterised by Mr. Wood as one of the leading potential beet growing areas in the Province.

OVERSEAS TRADE.

The Officer-in-Charge of His Majesty's Trade Commissioner's Office in Vancouver reports that authority has recently been granted for the raising of a loan of 495,000 dollars for the purpose of erecting new school buildings and extensions and for the equipment of a technical school in Western Canada.

United Kingdom firms interested in this matter as offering possible opportunities for the supply of technical school equipment, building materials, hardware, sanitary ware, etc., may obtain further particulars on application to the Department of Overseas Trade.

In the December issue of *School Science Review*, Mr. A. Sutcliffe gives a historical sketch of students' laboratories in England.

GENERAL NOTES.

MINING IN QUEBEC.

Mineral production in this Province has been increasing consistently year by year for some time past, and the twelve months ended December 31, 1928, were characterised by unprecedented activity in the mining industry of Quebec. The total value of the production of mines and quarries in the Province last year reached the new record of $37,325,287, an increase of 28 per cent. as compared with the 1927 total of $29,124,110. With the entry of Quebec into the metal mining field, the Province starts a new era, and continued growth in the value of production is assured. The figures for 1928 included metallic minerals valued at $8,127,182, representing 21.8 per cent. of the total output as compared with building materials, which accounted for 45.8 per cent., and other non-metallic minerals representing 32.4 per cent. Metal mining in Quebec has been greatly encouraged by the recent increase in copper, lead and zinc prices, the average price of copper during the year being the highest yearly average since 1920.

The principal individual item in value on the list of mineral products of Quebec in 1928 is, as usual, asbestos, in respect of which the Province contributes between 70 per cent. and 75 per cent. of the world's tonnage output and 55 per cent. of the world's production value. Other minerals contributing to the list of non-metallics are feldspar, graphite, magnesite, mica, phosphate, quartz, and soapstone, all of which, with the exception of mica and soapstone, showed increased values as compared with 1927. The production of building materials reached a record total.

Both prospecting and mining development were actively pursued during 1928 in the three regions which have commanded the interest of the mining public during the last few years, *viz.*, Western Quebec, the Chibougamau district and the Gaspe peninsular. Interesting mineral discoveries have also been made 100 miles north of Amos in the vicinity of Lake Mattagami, the source of the Nottaway River. Special reports on activities in these fields last year are contained in the volume under review.

Interesting mineral exploration work was also done in Ungava on the east coast of Hudson Bay and James Bay, particularly in the regions of Great Whale River and of Richmond Gulf, air transportation being extensively used for carrying men, provisions, and equipment.

NORTHERN ALBERTA BITUMINOUS SANDS.

Petroleum Extraction Tests.

A test of the new Laughlin filter for extracting oil and gasoline from the bituminous sands of Northern Alberta was recently conducted at Edmonton. The results are stated to have been quite satisfactory for the first effort, and the plant is now closed pending alterations. The oil obtained is reported to have been pure and absolutely free from sand.

The present plant is an experimental one able to handle 100 to 150 tons of tar sands per day. The machine works on the principal of a cream separator, separating the lighter liquids in a solution from the heavier, and Mr. W. E. Laughlin claims that a barrel of oil can be obtained from a ton of sand used.

The method has the merit of low costs. The sand is elevated to a large overhead vat by a chain to which scoops are fixed at intervals. In the vat it is mixed with water and the temperature raised almost to boiling point in what they call the cooker. At this stage the heavier particles of sand settle to the bottom while the lighter with the water and oil is drained off into a large funnel. Here a further settling process takes place. The water with the sand and oil is then admitted to the centrifuge where the final separation takes place. It is electrically operated, and works on the same principle as the cream separator, except that it goes a step further; it removes the sand. Liquids can be separated from liquids or from solids, provided that their specific gravities are different.

The successful adaptation of the new plant to commercial practice would bring into existence a vast industry at McMurray, the northern terminal of the Alberta and Great Waterways section of the Northern Alberta Railway. The bituminous sand deposits in the neighbourhood of McMurray cover thousands of square miles, exposures, some of which are over 200 feet in height, being found for a distance of more than 100 miles along the Athabaska River and for considerable distances up the tributary streams. The extraction of oil on a commercial scale from these sands has for many years presented an interesting problem to research chemists, and the application of the simple centrifugal principle is a novel method of recovery. According to the *Edmonton Journal*, the experimental plant has been successful in extracting 32 gallons of hydro-carbons per ton of bituminous sands. From every barrel of the black vis-

cous hydro-carbon containing naphtha, fuel oil, lubricating oil, kerosene, and asphalt, may be refined, it is said, 13 gallons of the very best " anti-knock " gasoline. 6 gallons of the finest grade of libricating oil, and from 110 to 120 lbs. of asphalt declared by experts to be of a much higher grade than the famous asphalt of Trinidad.

The cost of production per barrel of these valuable hydrocarbons is estimated to be less than 50 cents. The *Journal* states that the Company is amply financed, and that the first unit of the permanent plant to be erected next summer at or near McMurray will handle upwards of 500 tons of bituminous sands daily as compared with the 70 tons being put through the experimental plant at Dunvegan Yards.

The initial stage in the operation takes place in what is described as a " pug mill " in which hot water and steam are used to wash the oil impregnated sands clean of their hydrocarbons. Much of the heavy sand falls away from the mass at this stage, leaving the oil, water and lighter sand to drop into the centrifugal machine where rapid separation of the oil from the sand and water takes place.

TELEPHONE ENTERPRISE IN CANADA.

The Bell Telephone Company of Canada expects during the next five years to spend on extensions and replacements $16,000,000 and to instal 250,000 telephones in the provinces of Ontario and Quebec.

Since the present operating organisation was established six years ago, its investment in telephone plant in service has grown by more than 106 per cent., the total at the present time being $144,000,000. The number of telephone stations has increased by 61.4 per cent. to the present total of 789,000; annual additions to plant have grown by 137.8 per cent. to the 1929 figure of $29,000,000, and the number of employees has risen from 12,700 to 19,200 an increase of 61.2 per cent.

The General Executive Headquarters of the Company are at Montreal, but in 1930 the organisation will be carried on in two independent operating areas, each with its own General Manager and complete administrative and engineering staffs. Toronto will be the headquarters of the western area comprising the whole of Ontario west of Trenton, while Montreal will be the headquarters of the Eastern Division.

BUSINESS OUTLOOK IN THE UNITED STATES.

Recent events on Wall Street have materially altered the American business outlook. It appears to be agreed that the most seriout immediate repercussions will be felt in the luxury retail trades, especially in those branches in which instalment selling has been most prevalent.

HOSPITAL SUPPLIES FOR CANADA.

In a Report by the Canadian Medical Association there is a statement to the effect that the general public are becoming more appreciative of the value of hospitals to the community, and that hospital expansion is proceedingly rapidly.

H.M. Senior Trade Commissioner in Canada has supplied a number of copies of " A Directory of the Hospitals of Canada," showing, *inter alia*, the number of beds, etc., and copies can be obtained on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (the reference No. 19467/8/29 should be quoted.)

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

BOARD OF TRADE ANNOUNCEMENT.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during November, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 656, of which 536 were from merchants or importers. To these should be added 2 cases outstanding on the 31 October, making a total for the month of 658.

IMPROVED WATER SUPPLY FOR OTTAWA.

Work has been begun on the construction of a new water purification plant to be erected on Lemieux Island in the Ottawa River at an estimated cost of $1,315,000. Excavation work has been begun and is to be completed in about 8 months. Tenders for the actual construction of the rapid sand filtration plant are expected to be called for on or about March 15 next with provision for completion by July 1, 1931.

The new works will provide the City of Ottawa with 84,000,000 gallons daily of clear, thoroughly filtered water derived from the Ottawa River.

SUICIDE BY MEANS OF COAL-GAS POISONING.

Dr. Waldo, in holding two inquests on suicides recently, made some pointed remarks and suggestions with a view of prevention. He said that a striking increase in cases of suicide throughout Great Britain had occurred of late years, there being one and a half as many cases at the present time, after allowing for the increase in population, since 1856. The majority of cases heading the list were now due to poisoning by carbon monoxide contained in coal gas. Next in point of frequency came drowning. The same order of frequency, for 1928, obtained in his jurisdictions in the City and Southwark—closely followed by lysol poisoning.

The first of the two cases of suicide referred to by him was that of a man, who, after tasting lysol from a bottle, burne his lips, and, apparently, not liking the taste, spat it out, and then proceeded to hang himself with the window-blind cord.

The second case was that of a woman who placed her head on a pillow in a domestic gas oven, with the tap turned on, and so killed herself.

Dr. Waldo said he was of opinion that every possible, practical means ought to be taken in the removal of opportunity given in the way of coal gas and other poisons to suicides, and which poisons were also the cause of many accidental deaths.

With a view of prevention, Dr. Waldo made the two following suggestions :—

(1) The mixing of irritating formalin with coal gas in order to make it unpleasant to the smell as well as to cause the eyes to water, with possible sneezing. Formalin, unlike some other chemicals, would not cause dangerous corrosion of the gas pipes.

(2) The non-publication by the Press of the morbid details of letters left behind by suicides, which frequently led (in Dr. Waldo's 28 years' experience as a Coroner), by means of imitation through suggestion, to similar cases of suicide, besides acting grievously on the minds of relatives and suicides.

Dr. Waldo said it had been given in evidence lately at four fire inquests in Embankment subways—fitted with gas mains and electrical cables—that carbon monoxide had been rendered still more dangerous owing to this dangerous inodourous gas having been mixed in increased quantities with coal gas. It was also suggested that the characteristic odour of gas was less of late years.

NATIONAL MARK FOR PHARMACEUTICAL MALT EXTRACT.

With the object of improving the market for home produce, the Ministry of Agriculture has adopted a policy for the grading and standardisation of the agricultural products of this country, and for applying a distinguishing mark as a guarantee of quality and origin to the graded produce. The mark used, known as the National Mark, consists of a small silhouette map of England and Wales, with a circular representation of the Union Jack in the centre, associated with the words " Produce of England and Wales " and " Empire Buying Begins at Home."

In accordance with the above policy, the Minister has recently promulgated grades and standards for various kinds of malt products made entirely from home-grown grain, and among these the attention of the medical and pharmaceutical professions is particularly invited to the "All-English (Pharmaceutical) Malt Extract " sold either with or without cod liver oil.

Over and above a general provision regarding the purity and soundness of the barley or malt from which this extract is obtained, definite standards are laid down for the product in respect of various factors. The specific gravity, for instance, must not be less than 1.4 and the soluble protein content must be at least 5 per cent. of the total weight. A Lintner value of 25 is the prescribed minimum for diastase. When sold in conjunction with cod liver oil, the mixture must contain a definite percentage —*viz.*, 15 per cent. of oil. The Pharmacopœia Commission has been consulted and has concurred in the new standard.

It is admittedly possible for some exception to be taken to the fact that only one standard of All-English (Pharmaceutical) malt extract will be sold under the National Mark, since it is impossible to standardise patients, and medical opinion is not unanimous with regard to the efficacy of certain of the factors concerned.

The value of diastase as an aid to digestion, for example, appears in certain cases open to question, but as a general index of vitamin content, it is a distinct asset, and its value cannot be ignored. Heat which will kill the diastase will generally also destroy some of the vitamins. The diastatic activity of National Mark Malt Extract may therefore be taken as an indication that a proper and suitable process of manufacture has been observed throughout.

Experiments show that as a vehicle for carryin gaccessory food factors, the ordinary malt extracts of commerce have very widely different values. It is hoped, therefore, that the medical profession will appreciate the advantage of having at hand an agent like National Mark (Pharmaceutical) Malt Extract, which can be used with reasonable precision for dealing with the numerous obscure phases of deficiency diseases.

It has been claimed that the protein present in malt extract made from homegrown grain is to a greater degree and altogether more easily assimilated than that of imported extracts, or extracts made from imported grain. Whether it be entirely a question of nutritive value, or one of freshness and palatability, there seems to be something in the idea that the product of the clean, sweet, fresh malted barley, from the fields of our own country-side is better in every way than any other for pharmaceutical purposes, and justifies a serious claim for the extended use of National Mark (Pharmaceutical) Malt Extract.

National Mark (Pharmaceutical) Malt Extract will be placed on the market in the usual way in retail pharmacists' shops in amber glass jars covered with a blue and white seal label bearing the National Mark. It will also be available in wholesale quantities for hospitals and large institutions in containers bearing a similar label.

ACHEMA VI.

The Achema VI is particularly interesting in view of the section devoted to the exhibition of machinery and apparatus in the Artificial Silk Industry.

As has been announced already, the forthcoming jubilee exhibition of the " Achema VI " the exhibition of chemical apparatus to be held at Frankfort-on-Main, will be accompanied by a comprehensive exhibition of the machinery, apparatus and auxiliary material used in the production of artificial silk. This second exhibition will be confined to the technical limits adopted hitherto for the Achema. These limits may be defined as showing the process " from the tree trunk to the woven thread." The inclusion in the exhibition of machinery and apparatus for work upon the woven thread has not been provided for.

Numerous firms which construct complete installations for the fabrication of artificial silk have promised their participation. It is very probable that a complete installation for the weaving of artificial silk will be presented in working.

PIG IRONS.

WORKINGTON WEST COAST HEMATITE IRONS.

Foundry managers and metallurgists and manufacturers of malleable castings will find considerable interest in a brochure published by the Workington Iron and Steel Branch of the United Steel Companies Limited. This contains notes of the various grades and brands of pig iron made at the Cumberland Works, notably the " Distington," " Workington," and " Harrington " brands, together with some excellent photographs of fractures, and complete analyses of all grades.

With the aid of this booklet those who buy and mix pig irons either by fracture or by analysis can determine the iron best suited to their uses, with a minimum of trouble.

Some pig irons undoubtedly possess "personality." In addition to the properties indicated by the analysis, they possess others, scarcely definable, which are none the less most marked. Such pig irons have achieved a repute which carries the lemand for them even to far overseas countries.

The Workington and Distington " West Coast Hematite Pig Irons " exhibit this " personality " to a high degree. The notable reputation which they enjoy amongst foundrymen is, of course, based upon their freedom from deleterious constituents, but beyond that they have properties which experience has taught to be especially suited to various specific uses. We have heard it expressed that they have " body."

They owe their " personality " to the particularly rich and pure Cumberland hematite ore from which they are made.

To this is due the remarkable " strength " and consistency of the Workington Hematite Pig which are described in the booklet. This unified control is a valuable asset to the foundryman, and is well acknowledged in many countries. In their difficulties, foundrymen turn to West Coast Hematite Pig, and are usually rewarded by the improvements in castings which follow.

Copies of the Publication (W109) can be obtained on request from the Publicity Dept., The United Steel Companies, Ltd., Sheffield.

CANADIAN RUBBER MANUFACTURERS.

Canadian manufacturers of rubber products turned out goods last year valued at over 97 million dollars. This total included rubber tyres and tubes worth nearly 50 million dollars, and rubber footwear valued at 32 million dollars.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, December 5.

Papers read :—

Electron Scattering in Mercury Vapour. By F. L. Arnot. Communicated by J. Chadwick, F.R.S.

The Rate of Emission of Alpha-Particles from Radium. By F. A. B. Ward, C. E. Wynn-Williams and H. M. Cave. Communicated by J. Chadwick, F.R.S.

The number of α-particles emitted per second by 1 gram of radium has been determined by a direct counting experiment with a new type of electrical counter in which the whole of the amplification was produced by triode valves. The amplification was linear, so that the counting of α-rays was undisturbed by the presence of β-rays. It was found possible to count with accuracy at a high rate, *i.e.*, about 500 particles per minute. Approximately 10^5 α-particles were counted and the value found for the rate of emission from radium was 3.66×10^{10} α-particles per second per gram of radium, in good agreement with the value of 3.69×10^{10} recently found by Braddick and Cave, and with recent measurements of the heating effect of radium and its products.

Investigation of the Passage of Fast Beta-Particles through Gases. By E. J. Williams and F. R. Terroux. Communicated by Sir Ernest Rutherford, P.R.S.

The primary ionisation, in oxygen and hydrogen, has been determined for Beta-particles of .5 to .9 of the velocity of light, by means of the Wilson cloud chamber. For velocities approaching that of light, the values appear to approach limits of 22 ions per cm. in oxygen, and 5 ions per cm in hydrogen. The frequency of branch-track formation in oxygen was also determined, within the same velocity range. In both cases the values obtained and the law of variation with velocity were appreciably different from those predicted on classical theory. It appears, from the frequency of branch-tracks, that the magnetic moment of an electron is considerably less than a Bohr magneton. Momentum appears to be conserved in branch collisions.

Papers read in title only :—

On the Stresses in the Neighbourhood of a Circular Hole in a Strip under Tension. By R. J. C. Howland. Communicated by L. N. G. Filon, F.R.S.

The problem of determining a stress function bi-harmonic in a strip, perforated by a circular hole and satisfying given conditions on the boundaries, is solved by successive approximation for the case in which the stress-system is symmetrical both about axis of strip and about perpendicular diameter of hole. General formulæ are given expressing each approximation in terms of the preceding. The coefficients of the transformation depend upon transcendental integrals which are estimated numerically and coefficients are then tabulated. The method results in the expression of stress-function by a series with limited range of convergence, outside which the continuation of the divergent part of the series is given by an integral.

In the special tension problem the process leads rapidly to a satisfactory solution, when the ratio (λ) of diameter of hole to diameter of strip does not exceed 0.5. Coefficients in the series for the stress-function are tabulated for $\lambda = 0.1$, 0.2, 0.3, 0.4 and 0.4, and stresses round hole and on axes are found. Stresses at greater distances on axes and on edges of strip are computed from the integral formula for $\lambda = 0.5$ only.

The results are qualitatively similar to those obtained by optical methods, but extremes of stress are more marked. With $\lambda = 0.5$, greatest stress at boundary of hole is nearly $4\frac{1}{3}$ times tension at infinity. On the edge tension rises from a minimum of less than $\frac{3}{4}$ of applied tension at point nearest to hole, to maxima, not much less than twice applied tension, at distance of about one-third width of strip on either side of central section. On the axis disturbance due to hole becomes inappreciable at a distance from centre of hole equal to about $1\frac{1}{2}$ times width of strip.

ROYAL INSTITUTION.

A general meeting of the Members of the Royal Institution was held on Monday, December 2, Sir Robert Robertson, Treasurer and Vice-President, in the chair. On behalf of the Members Sir James Crichton-Browne presented Mr. Henry Young, late Assistant Secretary, with a silver rose bowl and cheque on his retirement after 50 years' service in the Institution. Mr. C. F. Burgess, Mr. J. G. Crowther, Dr. E. L. Kennaway, Mr. E. H. Selby, Mrs. L. M. Shorter, Mr. D. O. Sproule, Mr. G. Stubbs, Mr. P. J. Waldram and Mr. H. Young were elected Members.

THE CHEMICAL SOCIETY.

Thursday, December 5.

Passivity of Metals. Part III. The Quantity and Distribution of the Superficial Oxide. By U. R. EVANS AND J. STOCKDALE.

A new method for the removal of the surface skins of metals, dependent on anodic undermining, has been worked out with a view to preserving the metal enclosed in the oxide-layer; it is often possible to transfer the film to glass coated with nitrocellulose. Films have been removed from several fresh materials, such as nickel and carbon steel, whilst a transparent skin has now been isolated from "stainless steel." The oxide on heat-tinted nickel appears to be sharply divided from the metal, whilst on copper and iron there is interlocking. Some determinations of the oxides per unit area have been made. On yellow-tinted iron, undermining can be carried out at one of two different levels: undermining at the upper level yields a transparent film consisting of oxide alone in an amount agreeing fairly well with Constable's optical determinations, whilst undermining at the lower level gives a film with a greater amount of oxide and considerable amounts of metal. The dieulty of film removal varies enormously in different cases, and is usually greatest when the film is very thin and highly protective, but it is also increased when the continuity is interrupted by coarse abrasion or by the presence of heterophase impurities.

The Argentothiosulphuric Acids and their Derivatives. Part I. The Preparation of the Sodium Salts and the Isolation of Monoargentomonothiosulphuric Acid. By H. BAINES.

Results given in the literature for the analysis of the sodium argentothiosulphates do not agree. The sparingly soluble salt has been found to have the composition $Na_3S_2O_3$, $Ag_2S_2O_2$, $2H_2O$, or $Na(AgS_2O_3)$, H_2O, and the soluble salt, $Na_5[Ag_3(S_2O_3)_4]$, $2H_2O$. Evidence is advanced for the existence in solution of a salt $Na_3[Ag(S_2O_3)_2]$. The names sodium monoargentomonothiosulphate, triargentotetrathiosulphate, and monoargentodithiosulphate are suggested.

A new method of preparation of the first salt, giving a very pure stable product, is described. Washed silver carbonate precipitated from 75 c.c. of *N*-silver nitrate is added in aqueous suspension to 100 c.c. of *N*-sodium thiosulphate and the volume adjusted to 250 c.c. Sodium sulphite (10 g. anhydrous) is added, and a slow stream of sulphur dioxide is passed through the solution, from which the sodium monoargentomonothiosulphate separates on saturation and keeping. Crystal data of the salt are given.

Sodium triargentotetrathiosulphate is prepared by dissolving in 80 c.c. of *N*-sodium thiosulphate a suspension of silver carbonate (precipitated from 40 c.c. of *N*-silver nitrate) in 40 c.c. of water. Alcohol (140 c.c.) is added and the precipitate separated.

Monoargentomonothiosulphuric acid was isolated by acidifying with nitric acid an ammoniacal solution of sodium monargentomonothiosulphate. The unstable white precipitate was separated and found to have the constitution $H(AgS_2O_3)$, H_2O. Attempts are being made to isolate triargentotetrathiosulphuric acid. An aqueous solution of the acid has been prepared by treating barium triargentotetrathiosulphate, $Ba_5[Ag_3(S_2O_3)_4]_2$, $10H_2O$ with sulphuric acid.

Sugar Carbonates. Part IV. The Dicarbonates of Glucose, Fructose, Mannose, Galactose and Arabinose. By W. N. HAWORTH AND C. R. PORTER.

The above crystalline compounds have been prepared by the condensation of sugars with carbonyl chloride in pyridine solution. They exhibit properties which differ from those of the corresponding diacetone compounds although the constitutions are closely allied to the latter.

Isolation of Crystalline α- and β-ethylglucofuranosides (γ-ethylglucosides) and Other Crystalline Derivatives of Glucofuranose. By W. N. HAWORTH AND C. R. PORTER.

The two stereoisomeric forms of γ-ethylglucoside have been isolated as crystalline substances. These are found to possess properties closely similar to those of Fischer's liquid product, γ-methylglucoside, and it is apparent that the latter is an impure mixture of α- and β-forms. The isolation of the new compounds is a striking confirmation of the constitutional views appertaining to the sugar group, and has an important bearing on ring structure. Furthermore, glucofuranose-5 : 6-monocarbonate has been isolated as a crystalline sugar representing the first authentic example of a crystalline γ-sugar derivative having a free reducing group. Several other compounds allied to this series have been isolated and are described, including the crystallilne anilide and osazone of glucofuranose-5 : 6-monocarbonate.

SOCIETY OF GLASS TECHNOLOGY.

At the meeting of the Society of Glass Technology held in the University, Leeds, on Wednesday, November 20, a general discussion took place on "The Function of Cullet in Glassmaking." The discussion was introduced by the two following papers, namely :

...*The Effect of Repeated Re-melting of Glass in Sillimanite and in Fireclay Pots.* By A. A. Childs, Violet Dimbleby, M.Sc., H. W. Howes, M.Sc.Tech., and Prof. W. E. S. Turner.

The Effect on some Physical Properties of Glass Repeatedly Melted in Platinum. By Violet Dimbleby, M.Sc., H. W. Howes, M.Sc.,Tech., F. Winks, M.Sc.Tech., and Prof. W. E. S. Turner.

Professor Turner dealt with the two papers together, as the work described in the second was the outcome of difficulties met with in the first investigation. In previous papers were described the effects of varying the proportions of batch and cullet in soda-lime-silica and in potash-lead oxide-silica glasses. The present investigations were undertaken in order to test the effect of repeated re-meltings on the composition and working properties of the same glass originally made from batch. The first series of tests were conducted using a simple lime-soda-silica glass, made and re-melted many times in a sillimanite pot. The glass made from batch was worked from the pot, broken up, returned to the pot, re-melted, worked out again, and samples taken. The bulk was broken up, returned to the pot, re-melted, worked out, and further samples had been obtained, each representing a definite number of re-meltings of the same glass.

The amount of corrosion observed on the pot after the re-meltings of cullet was astonishing, and was confirmed by the irregular, yet considerable percentage of ferric oxide and alumina found in the glasses on chemical analysis. A second series of glasses were given in full and revealed a diminution in soda as the re-meltings progressed, but it was not obvious, from simple inspection, whether this diminution in the alkali was due to actual loss or to change in the proportions of the constituents due to the absorption of material from the pot.

The glass worker reported a shortening of the working range, and an increase in brittleness of the glasses with each re-melting. The glasses also became darker in colour.

The absorption of a considerable quantity of pot material by the glasses vitiated all attempt to determine the effect of re-melt-inging alone on the physical properties of the glasses. A further series of re-meltings using a harder glass was carried out in exactly the same manner in a fireclay pot, but this time the pot attack was greater than in the sillimanite pots, although the glass used was of lower soda content than in the earlier series. A series of annular depressions were formed in the pot walls corresponding to the level of the metal in the successive meltings. It was useless to employ these glasses for tests on working or physical properties.

A further investigation was, therefore, undertaken, glasses being made and re-melted repeatedly in platinum to eliminate as far as possible the corrosion of the vessel. Of necessity the amount of glass made was small. A very small amount of platinum was dissolved into the glass but this was very minute and negligible for the purposes of this investigation. Two series of glasses were made as in the sillimanite pots, and it was found that three repeated meltings were necessary before these small melts were homogeneous. Accordingly a third set of re-meltings were completed, the glass being crushed and re-melted twice before any samples were taken for test. Seven samples were obtained, each representing a further re-melting. The chemical compositions, the densities, annealing temperatures, and thermal expansions of the glasses were determined. It was found that the chemical compositions varied, but slightly throughout the whole number of samples. There was a slight tendency to diminution of soda as the re-melting proceeded, but the differences found were not appreciably greater than analytical error. Very little variation was found in the annealing temperatures, or the densities, or the thermal expansions of the glasses.

In conclusion, Professor Turner stated that so far as those properties examined were concerned, the re-melting of a homogeneous glass did not effect any appreciable change. The cullet problem seemed to be a problem of diffusion, and if cullet were properly crushed and mixed intimately with the batch, then it should be possible even to employ "foreign" cullet within reasonable limits successfully.

THE GEOLOGICAL SOCIETY.

Wednesday, December 4.

Communication read :—

Foliation in its Relation to Folding in the Mona Complex at Rhoscolyn (Anglesey). By EDWARD GREENLY, D.Sc., V.P.G.S.

Further studies on the major anticline of Rhoscolyn have thrown much light on successive stages of the metamorphism.

The major, minor, and minimum foldings (with their thrustings) have each given rise to a foliation; that produced by the major folding being, on the nearly horizontal core of the large anticline, conspicuously transverse to the bedding of the massive grits of the South Stack Series. Yet it is thrown into isoclines by the minor folding, which is therefore subsequent to it. Where the cross-foliation of the major folding has been isoclinally folded, the foliation of the minimum folding runs right up to it at any angle without being itself folded in the least, whence it follows that the minimum is later than the minor structure. Thus the three foliations (major, minor, and minimum) *developed in chronological order.*

Major thrusts often truncate the minor isoclines, and on decapitated anticlines where the beds are steep the beds above and below the thrust have been made to interdigitate. Sometimes this is carried so far as to drive long wedges of thin grits in between the laminæ of the major cross-foliation. In this manner the structures usually found at a thrust-plane have often been completely obliterated, even when the thrust is considerable.

The relations of major to minor folding furnish an explanation of the fact that the major cross-foliation, unlike a slaty cleavage, fails to traverse the pelitic beds. The foliation of the plutonic intrusions, and the tremolite-schists, are products of the major movements.

In 'The Geology of Anglesey' the principal metamorphism was ascribed to the major and subsequent movements. Re-examination has shown, on the contrary, that this metamorphism is independent of and older than all three. Its foliation is developed along innumerable thrusts, but these are at angles so acute to the bedding that, especially when thrown into rapid isoclines, they easily escape notice. This is the true explanation of 'monoplanic schists.'

The Avonian Succession in the South of the Isle of Man. By HERBERT PRICE LEWIS, M.A., F.G.S.

The rocks described occupy a 'key' position in relation to carboniferous rocks of the Irish Sea area. They lie within a basin, which is partly tectonic, between the Port St. Mary-Arbory Fault on the north-west, and the line of the Langness Ridge on the south-east.

NOTICES OF BOOKS.

National Physical Laboratory Report for the Year 1928. Pp. vi + 283. His Majesty's Stationery Office, London. Price 9s. net.

The monumental work of this large institution is well known, but perhaps some may not realise the scope of the work undertaken. Turning to the index the following range of subjects will give some idea of the research and test work going on. Acetylene, Acoustics, Aerials, Aerodyuamics, Aerofoils, Aeronautical research, Aeroplane engines, tests etc., Age-hardening of light alloys, Air humidification, Aircraft tests, Airscrew research, Airships, Alloys, Alternating current measurement, Amalgams, dental, Ammeters, Amplifiers, Automobile headlights, etc., etc. Even under A some *items and various details are omitted here.*

The research committee contain the famous names of Sir J. J. Thomson, Sir Wm. Bragg, Sir Richard Glazebrook, Sir E. Rutherford, Sir Arthur Schuster.

The Electrical Units Committee, High Tension Committee, and the Advisory Committee for Metallurgical and Engineering Research on Materials, are represented by well-known names of men in science and engineering.

This large volume ($10\frac{1}{2}'' \times 8''$) gives an outline of the work undertaken and in many cases, practically complete papers are given, or at least a considerable amount of material together with diagrams and plate illustrations. For example opposite page 115 photo-reproductions in half-tone are given of compressional vibrations of a quartz disc and also its overtone flexural vibrations. Opposite page 101 is given a photo-reproduction in half-tone of a million-volt spark. This was the product from their high-voltage laboratory, one of the finest in the world.

The physics department is very complete. The director is Dr. Sir J. E. Petavel, F.R.S. The superintendent is Dr. G. W. C. Kaye, wellknown for his work on X-rays.

There are other equally important departments but space will not permit of a personnel or selective treatment by way of example here.

The Laboratory Papers are listed being in number : 63 in 1927 and 83 in 1928. Also

a large number of "unofficial" papers are given in title.

Enough has been said to show the magnitude and scope of the work undertaken, much of which is of high precision, and no physics laboratory should be without a copy of the yearly report of the National Laboratory, which report is published at a very low price considering the enormous labour that has been put into it by experts and even the printing is a big undertaking. It speaks well for Governmental Work and all should be proud of this national achievement.

F. H. L.

Agricultural Society of England. Pp. 193. Price 1s. 3d. Post free.

The fourth volume of this annual summary of the scientific and economic research work in agriculture, not only at home but abroad, in so far as colonial and foreign results are of interest to agriculturists in this country, has now been issued. Started four years ago at the instance of the Research Committee of the Royal Agricultural Society, quite frankly as an experiment, the publication has now established for itself a definite place in the periodical literature of the farming industry. Farmers are naturally at a disadvantage not only in interpreting the results of scientific work but also in knowing where to look for them. They appear in a great variety of forms, in periodicals not always accessible to the farmer and couched in language not always easily understood by him. His work lies around him on his farm; he has neither the time nor always, in these days, the means to study a multiplicity of journals and pamphlets, and thus it happens that the results of research work are often too slow in reaching those who are most concerned to know about them. Collected from all available sources, put together by acknowledged authorities, in non-scientific language, the contents of *Agricultural Research* should be studied by all those who wish to keep themselves abreast of the times in modern agricultural practice.

It is impossible to do more than to give some indication of the subjects dealt with in the new issue. Arable farmers will be interested in the article on Sugar Beet which forms the opening section of Mr. Engledow's review of "Crops and Plant-breeding," whilst the portion in which he deals with the importance of securing a full and even "plant" in cereals is of particular value at the present time when the difficulty of getting an adequate financial return from corn crops is so real. Mr. Mackintosh has some useful observations on dairy farm management, and the economics of the production of clean milk, and the establishment of a tubercle-free dairy herd. The question of taints and flavours in milk is also dealt with by him. Under the heading of "Agricultural Economics," Mr. Orwin deals with factors in the cost of various farm products, and there is an exposition of the new Credit Scheme which should be useful at the present juncture. This scheme also contains a brief but useful summary of the economic position and the trend of events in the agricultural industry at the present time. In these days of high labour costs and low prices, the farmer is turning more and more to the use of machinery in the hope of increasing the output of labour, and the information contained in Dr. Owen's contribution on "Agricultural Engineering," dealing as it does not only with the efficiency of old and well-tried implements but also with new inventions such as those for rotary cultivation, the combine harvester-thresher, and the potato harvester, will receive close attention. Information is also provided on the important problem of lifting the sugar-beet crop. Dr. Crowther, as would be expected, has much to say on recent work in "Animal Nutrition," and the recent development of knowledge on the nutritive value of grass at different stages of its growth will be found of particular interest. "Soils and Fertilisers," form the subject of a valuable review by Sir John Russell, and his summary of research work on the manuring of the sugar-beet crop deserves careful attention. A section on green manure and the limitations of its usefulness under varying soil conditions is of great practical value. The volume concludes with Sir John McFadyean's summary of the progress of "Veterinary Research" during the year, particular attention being given to the control of tuberculosis and that other scourge of the dairy farmer, contagious abortion.

For the assistance of students and others desirous of consulting original sources of information, each section of *Agricultural Research* concludes with a complete bibliography of papers quoted. The Royal Agricultural Society, it should also be noted, is continuing the sale of the volume at the reduced price of 1s. 3d. post free, in order to secure the widest possible circulation. To members of the Society it will be sent free on application.

**The Kinetics of Chemical Change in Gaseous Systems.* By C. N. HINSHELWOOD, M.A., F.R.S. Second Edition. Pp. iv + 266. London : Humphrey Milford, Amen House, Warwick Square, E.C. Oxford : The Clarendon Press. 1929. Price 12s. 6d.

The author has given, in this volume, a continuous account of those physical phenomena of chemical change which may be interpreted in terms of the kinetic theory of gases.

After an explanatory and rather mathematical Introduction, a full account is given of Bimolecular Reactions, then the Energy of Activation, Ter- (tri-) and Uni-molecular Reactions, Chain Reactions, the Kinetics of Heterogeneous Reactions, etc. Much of the early portions of the first edition have been re-written or enlarged whilst Chapter VI has been added.

Physicists, physical chemists, and lecturers should find the new edition of interest and value.

Forthcoming Events.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

A meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, 18 December, at 7.30 for 8 p.m. The following papers will be read and discussed :—

"A Trifoliate Pedicellaria in *Echinus miliaris*." By W. Wall.

"A Microscope Lamp." By F. V. Welch, F.R.M.S.

"Note on Dark Ground Illumination." By J. E. Barnard, F.R.S., P.R.M.S.

The Annual General Meeting of the Society will be held on Wednesday, 15 January, 1930, when Mr. Joseph E. Barnard, F.R.S., P.R.M.S., will deliver the Presidential Address.

The Biological Section will meet in the Library on Wednesday, 1 January, 1930. Hon. Secretary : Mr. D. J. Scourfield, I.S.O., F.L.S., F.Z.S.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Friday, December 13, at 9 p.m.—"Cave Excavation in the Near East." By Miss D. A. E. Garrod.

INSTITUTE OF RUBBER TECHNOLOGISTS.

Manchester Cafe, Ltd., Exchange Buildings.

Thursday, December 19. — "Reclaimed Rubber." A number of papers will be read.

UNIVERSITY COLLEGE, LONDON

Thursday, December 19, at 5.30 p.m.—"Gaspare Gozzi." A public lecture in *Italian.*" By Mr. A. M. Bassani.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

34,828.—Imperial Chemical Industries, Ltd.—Apparatus for carrying out reactions. November 14.

34,501.—Imperial Chemical Industries, Ltd.—Carrying out exothermic gas reactions. November 12.

34,367.—I. G. Farbenindustrie Akt.-Ges. —Production of derivatives from alkylene oxides. November 11.

34,368.—I. G. Farbenindustrie Akt.-Ges. —Process for increasing dissolution of substances. November 11.

34,404.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azine derivatives. November 11.

Specifications Published.

321,425.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges). — Manufacture and production of readily-condensable nitric oxides.

321,399.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.)—Process for the production of organic acids.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

319,957.—Hydrogen.—Johnson, J. Y., 47, Lincoln's Inn Fields, London.—(I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany).

In the production of hydrogen by treatment of methane with steam the conditions are regulated so that 2-15 per cent. of methane remains in the gas obtained. This methane is subsequently removed either by washing with solvents or by converting it by means of air or oxygen. The carbon monoxide which is formed is removed by converting the greater part of it by means of steam into carbon dioxide and removing the latter by means of solvents. Remaining traces of monoxide are then removed by washing with a cuprous salt solution or by re-converting into methane. Alternatively the reaction product may be purified by washing with liquid nitrogen.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His

EPOCH.

506,673.—Base exchange water softening preparations, being chemical substances in class 1, for use in water softening apparatus. — Electrolux, Ltd., 153 & 155, Regent Street, London, W.1. November 20th.

LANCIA.

506,703.—Developing, fixing and toning preparations, being chemical substances for use in photography.—W. B. Cartwright, Ltd., Lakeside Works, Mount Vernon Road, Larkfield, Rawdon, near Leeds. November 20th.

AVIROLAT.

507,007.—Chemical substances for use in the dyeing industry. — H. Th. Bohme Aktiengesellschaft, 29, Moritzstrasse, Chemnitz, Saxony,

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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ELEMENTS IN THE SUN.

(THIRD NOTE.)

CORRECTION.

In my article in this Journal of Dec. 13, 1929, page 372, 2nd column, 3rd line down, "τ" should read : τ^2; and on the next line "$\beta=c/v$" should read : $\beta=v/c$. These are my mistakes entirely which I should have seen in the proof.

F. H. LORING.

"ACTICARBONE."

By S. REGINALD PRICE, M.A.

The industrial use of activated carbons for the removal of volatile solvents from gases has lately been attracting considerable attention. For example, if a mixture of air and benzol vapour is passed through activated carbon the benzol is absorbed while the air passes forward. If now, the carbon is heated with hot steam or hot air the benzol is liberated and can be condensed. This principle is being applied on the commercial scale to the extraction of Benzol from Coal Gas, of Petrol from Oil Gas, and to the recovery of many solvents used in industry, for example Solvent Naphtha from India Rubber Works, Acetone and Ether from Artificial Silk manufactures, Benzine from Dry Cleaning Works, and the various solvents used in the manufacture of Celluloid, Films, Artificial Leather, Explosives, etc., etc.

The technical problems connected with this application have of course been considerable and much time and money has beeen spent in bringing the processes up to the present stage of efficiency. In this work the Société de Recherches and d'Exploitations Pétrolifères, of Paris, have taken a leading place, and their patents for the activated carbons and processes of application "Acticarbone" have now a wide industrial importance in France and the Continent. It is therefore of interest to note that Price, Stutfield & Co., Ltd., of 6, Fenchurch Buildings, E.C., have been appointed by them as their sole representatives for their carbons and processes "Acticarbone" for Great Britain and the Colonies. These processes are of course patented in Great Britain.

The activated carbons "Acticarbone" are manufactured in France by their patented process and reach high efficiencies of absorption. The processes for their application for solvent recovery, etc., are simple and show great economy of steam and power consumption, while the original capital is so small that the plant usually amortises its cost in 3-6 months.

In solvent recovery the solvent vapours and air mixture are collected from the working machines, drying rooms, etc., and even from the atmosphere of the work rooms, and drawn by a fan through a pipe system to the absorber. The gas stream passes through the absorber containing the active carbon "Acticarbone," and this absorbs the solvent, allowing the cleansed air to escape. The carbon continues to absorp till it

reaches its saturation or "break-point." The passage of gas is then stopped (or rather passed to a second absorber) and the charge is subjected to a heating process by circulation of dry steam to drive out the solvent which is condensed. After cooling the absorber is ready for another operation.

In the processes of the Société de Recherches and d'Exploitations Pétrolifères the carbon charge "Acticarbone" lasts without change or renewal for several years so that the costs on this account are very small. Recovery efficiencies of 90/95 per cent. of the solvent entering are regularly attained and the direct saving of valuable solvent thus made possible represents a very valuable reduction of working costs.

In the same way the value of the extraction of Benzol from Coal Gas, Coke Oven Gas or Low Temperature Carbonisation Gas results in an increase in the total sale price of the products obtained from distillation.

NEWLY OBSERVED LIGHTNING PHENOMENA AND THE ATOM.

By F. H. Loring.

In *Science* of November 22, 1929 (p. 501), G. Winchester records observing in daylight, what appeared to be a ball of yellowish-brown smoke, at the time of a lightning flash that was near enough to give a concussion effect. No destructive traces of a lightning discharge were afterwards found at the spot where the ball occurred or where the flash occurred. This cloud diffused into the air like smoke. The phenomenon could not have been due to dust as it had been raining for about two hours before the ball was observed.

Winchester raises the question whether in the dark the ball would have appeared luminous.

The formation of NO_2 might be also considered.

In London on the night of December 6-7 (current) towards and just after midnight a strong gale developed accompanied at first by lightning which is rather unusual at this time of the year. The wind velocity reached a maximum of 108 miles an hour at the Scilly Isles, apparently a record, while over London the velocity ranged between 65 and 68 miles per hour—taking the maximum which occurred after the thunderstorm mentioned.

During the thunderstorm it was reported that bright spots were seen in the night sky accompanied by flashes and loud thunder. The illustration here shown is based upon a photographic half-tone print in the *Evening News* of Dec. 7, 1929, which purports to represent a curious behaviour of the lightning as photographed at Ilford.

At first I thought that this photograph was *not* one of lightning at all, but an effect due to the movement of the camera; but it appears to be *knot* lightning which in respect of its 'massive' knots is reminiscent of a ball effect, though it may have nothing to do with ball lightning.

However this may be, ball lightning and any phenomenon *apparently* related thereto are of special interest in these days when so much energy is supposed to be locked up in the atom, or produced by the coming together of its constituents—protons and electrons—so as to annihilate each other and give rise to a flash of radiation.

This is a subject I have frequently discussed in these pages and ball lightning was considered in a few of its phases in a paper which appeared in the *Chemical News* (Vol. 128) of January 4, 1924, pp. 5-8. The following from this paper may be worth repeating here so as to unify the subject and make it unnecessary to turn back to the original :—

In these cases it may he assumed that some electrons are more or less discharged from the substance by the radiation absorbed, and then if the radiation of the proper wavelength falls on the substance, absorption may take place as "closed radiation," only to be emitted when the substance recovers internally or externally, the electrons displaced or completely removed (as the case may be), when the substance becomes wholly electrically neutral again.

Of particular interest, therefore, in this connection, is the phenomenon of ball lightning, known also as fire-balls, globular lightning, and thunder-bolts, though the last-named expression is used more by ignorant persons in reference to ordinary lightning discharges. Meteorites may be described as fire-balls, which confuse the meaning of this term, so that the first and third names are best.

Referring to this phenomenon, an interesting statement about thunderstorms and globular lightning appeared in *Nature*, Nov. 17, 1923, under the pen of Dr. G. C. Simson, where it is recorded that the chief characteristics of ball lightning, so far as known at present, are—

1.—"The body or ball itself, which is able to retain its individuality as it moves through the air, appears to be composed of gas or matter in some novel luminous condition.

2.—"The balls appear to exist independently of any large electrical intensity, for they have been observed within closed rooms, where large electrical fields are impossible; and also have been observed to pass in and out of parallel telegraph wires [they are known to come into the room from a chimney during a thunderstorm].

3.—"They appear to be associated directly or indirectly with large quantities of energy, for they have been observed to *explode with violence, and have also* been seen to fuse the overhead wire of an electrical tramway [this wire may be ⅜ of an inch in diameter]."

"No satisfactory explanation of ball lightning has been offered." Dr. A. Russell refers in this connection to a "brush discharge taking place in a column of air of higher conductivity than the neighbouring air." This is most suggestive, as will be seen from the next paragraph.

This phenomenon is of such rare occurrence that little opportunity has been afforded to study it; but it seems quite possible that the normal discharge of lightning might cause a body of free particles to become positively charged, owing to the photo-electric effect due to the ultra-violet light emitted by the discharge. If these particles are present in great numbers in a sort of self-contained cloud or whirl, they might then form nuclei round which the radiation of the concurrent, or a following, discharge could circulate, and thus form in a crude way a sort of huge atom. The stability of such a system would not persist indefinitely as the return of the electrons to their normal positions round the nuclei would restore equilibrium, but in the interval radiation would be emitted from such a system, according to the views developed in this study. (Prior citation ends here.)

It is just possible that lightning does release latent atomic energy in certain circumstances and these phenomena may be the result of a few atoms exploding, so to speak; or a few atoms of helium being formed by the polymerization of hydrogen into helium which would mean a release of very high-frequency radiation representing enormous energy as the following calculation shows :—

$4 \times 1.0072 = 4.029$.

$4.029 - 4.0011 = 0.028$ gram.

$0.028 \times (3 \times 10^{10})^2 = 2.5 \times 10^{19}$ ergs.

This is of course on a gram-atom basis using atomic nuclei in the calculation. The velocity of light is rounded to 3×10^{10} cms. per second, which is near enough for this example.

It is also of interest to observe here that the sun-spot activity is again considerable,

so that unusual or disturbed conditions on the earth may be traced *partly* to this phenomenon. I discussed sun-spot activity in the *Chemical News*, 1928, *137*, 129, pointing out that 1930 would possibly be in the region of very intense sun-spot activity, but the figures involved in these matters cannot be expected to be very accurate, as sun-spot periods do not show a perfectly regular frequency.

X-RAYS, ATOMS AND ELECTRONS.

On 5 December, Professor A. S. Eddington, who delivered the Silvanus Thompson Memorial Lecture at the Central Hall, Westminster, in connection with the British Institute of Radiology, spoke on " X-Rays in the Stars."

The astronomer utilised the results of the discovery of X-rays in his researches into the most inaccessible parts of the universe, said Professor Eddington. It was the practical knowledge of Xrays acquired through laboratory experiment which they applied to their study of the structure and behaviour of the stars. In astronomy they were not much concerned with the hard X-rays used in medical appliances, but the bulk of the radiation inside a star consisted of the softer kind of X-rays.

The surface temperatures of the stars ranged from about 3,000 deg. centigrade for the reddest, to about 20,000 deg. for the hottest types. Our sun had a surface temperature of nearly 6,000 deg., but soon reached 1,000,000 deg., and, it was calculated, showed 40,000,000 deg. at the centre. It was a remarkable fact that the great majority of the stars in the main series, differing enormously in brightness, in diameter, and in surface temperature, had, as closely as they could ascertain, a central temperature of 40,000,000 deg. Temperature was a way of stating how fast the ultimate particles of matter, the atoms or molecules, were moving. In the temperature of that room the atoms were rushing about in all directions with a speed of a fifth of a mile a second, but if the temperature could be heated up to 20,000,000 deg., they would be going at 50 miles a second.

Amid these particles moving at 50 miles a second there were vast quantities of X-rays, the quantity and quality of which were determined as soon as the temperature was known. At 20,000,000 deg. they knew just how much of each wave-length there was in each cubic centimetre. The material in the interior of a star was not a collection of ordinary terrestrial atoms, but of stripped atoms or ions together with vast quantities of free electrons which had been detached, but remained in the material travelling about with enormous velocities, as though they were little atoms on their own. The electrons enjoyed freedom for a short while, but were soon recaptured by the atoms. In a star the electron was scarcely given a chance to settle; the X-rays were on it, and forced it away again. The X-rays in the stars were in a sort of prison. Like the atoms and the electrons, they were rushing in all directions, never continuing far in any one direction. The X-ray went on for a few centimetres and was then absorbed. The total amount of X-ray radiation in the star remained steady, so for every absorption there must be a balancing emission. What really happened was that the X-rays drove out an electron from an atom, being itself absorbed in this process. The electron proceeded until it was captured by an atom; the electron disappeared into the atom, and the X-ray came out. The X-ray wandered aimlessly round, continually being absorbed and re-emitted in a new direction, but going round and round the maze in this way for a million years or so. It as last found an exit. So each year a certain proportion of the imprisoned radiation got to the surface, and supplied the heat which the sun and stars radiated into space.

NORTHERN IRELAND AND NEW INDUSTRIES.

By The Rt. Hon. John M. Andrews, D.L., M.P., Minister of Labour for N. Ireland.

It is often overlooked by many that the United Kingdom comprises Northern Ireland as well as England, Scotland and Wales, for cases frequently arise where business houses in England seem to be of the opinion that Customs formalities have to be satisfied in consigning goods to this portion of the kingdom. I wish to emphasise, therefore, that although certain legislative powers relating to domestic services were transferred to the parliament established in Northern Ireland in 1920, the province remains an integral part of the United Kingdom and constitutes with Great Britain one unit for fiscal purposes and matters of Imperial concern. The people in this part of the United Kingdom still retain their representation at Westminster, whilst electing members to deal with local matters in the Parliament of the Province. In effect, therefore, the constitutional settlement which set up Northern Ireland in 1920 affords an interesting example of the devolution of domestic services to a provincial Parliament within

the kingdom, the unity of which remains unimpaired for all general and Imperial services.

BRITISH STANDARDS.

Since the formation of the Government of Northern Ireland its deliberate policy has been, and I believe will continue to be, that social legislation and administration shall (with, of course, any minor modifications to meet the necessities of local conditions) be on lines parallel to those followed in Great Britain. To-day it can be asserted, practically without qualification, that our code of social legislation is as nearly as possible on equality with that of the predominant partner. Our workers enjoy the advantages of legislation under the Health and Unemployment Insurance Acts, the Contributory Pensions Act, the Old Age Pensions Acts, the Factory Acts, the Trade Board Act, and the Workmen's Compensation Acts, on the same scale and under contitions almost identical with those enjoyed by their fellow workers across the Channel. It is true that we inherited a Health Insurance scheme under which our insured population has not hitherto enjoyed the advantages of medical benefit, but steps are now being taken to alter the law in this respect in order to give the same kind of medical service as is available in England. With regard to all these services our workers and their employers have the additional advantage that, as they are all vested in the Ministry of Labour, and so administered by one department, there is a higher degree of co-ordination and dispatch than is possible in Great Britain under present conditions. Our commercial code similarly coincides with that in force in England.

Northern Ireland comprises an area of 5,237 square miles, with a population which, as the census of 1926 showed, has grown to over 1,256,000 persons. The population approximates to that of New Zealand and is more densely distributed than in Scotland—the average number of persons per square mile being 240 as compared with 164 in Scotland. Local Government administration is modelled on the English system; there being six counties—Antrim, Armagh, Down, Fermanagh, Londonderry and Tyrone—and two county boroughs—Belfast and Londonderry.

AN EXPORTING COUNTRY.

The province is partly agricultural and partly industrial in character. It is essentially an exporting country, and in proportion to its area and population makes a remarkable contribution to Empire and world trade. In no other part of the kingdom does agriculture hold such an important place, and on the industrial side linen and shipbuilding are its mainstays. There is also a valuable trade in marine and general engineering, ropes, tobacco, soap, shirts and collars, hosiery, felt, whisky, mineral waters, flour, jam, biscuits, pottery, cement, matches and other commodities.

It is essential for the prosperity and economic stability of any community that competes in the world's markets that its industries should be numerous and varied in character. In order to foster the establishment of new manufactures and to indicate the advantages that Northern Ireland has to offer to those proposing to establish new factories, an Industrial Development Association has just been formed of representatives of the financial, commercial and manufacturing interests in co-operation with the Government.

POSITIVE ADVANTAGES FOR NEW INDUSTRIES.

On the more positive side Northern Ireland, as a manufacturing and distributive centre, has many substantial claims to recognition which if more widely known would undoubtedly result in an influx of new industries. It is well supplied with harbours from one end of its coast line to the other. The port of Belfast is one of the finest in the United Kingdom, accessible at all states of the tide, independent of dock gates, with their expensive delays, and possessing six miles of quays, well equipped with cranes, and railway lines which afford easy connection with the railway system and make the port an ideal distributing centre. Steamers sail daily to and from Heysham, Liverpool, Glasgow and Ardrossan, while there are regular direct sailings to at least fifteen other British towns in addition to various foreign ports.

Londonderry, as a business city and seaport, ranks next in importance to Belfast and offers admirable services and facilities in a proportionate degree. Coleraine, Larne and Newry are also enterprising ports, with numerous smaller ones situated on the 245 miles of seaboard. The London, Midland and Scottish Railway Company runs steamers daily between Heysham and Belfast and between Stranraer and Larne, connecting its system in England and Scotland with the network of railways that it owns in Northern Ireland, on which it has been spending large sums of money in recent years in capital improvements.

Inland, linked up by excellent railway and road communications, there lie many industrial centres, readily capable of further development, which would well repay the consideration of any prospective founder of a new or additional industry.

I am not overstating the case when I say that from every point of view Northern Ireland possesses many advantages for the establishment of new industries. Its population is increasing, one of many evidences of its social and economic progress under its measure of self-government. It offers a wide range of suitable sites for factories—probably a larger choice is available than in any similar area in Great Britain. Local rates and taxes arer invariably lower than those levied in other industrial and semi-industrial parts of the United Kingdom, and the same reliefs have been granted under our Derating Act as have been afforded in Great Britain. Gas or electricity, or both, are usually available at or near to all the urban centres, and special inducements are offered to industrial consumers. That there are abundant supplies of pure water is proved by the extensive developments of bleaching and dyeing and the manufacture of mineral waters. The relations between employers and workers are harmonious. And, probably most important of all, there is a working population second to none in intelligence, skill and industry.

LOAN GUARANTEE ACTS.

To the foregoing reasons for regarding Northern Ireland as a first-class centre for embarking on new industrial undertakings, the additional one should be added that the Government under its Loans Guarantee Acts guarantees the payment of the interest and principal of loans made for the purposes of carrying out a capital undertaking, where the application of the loan in the manner proposed is calculated to promote employment in Northern Ireland. Guarantees already given amount to almost £10,500,000, and cover such purposes as shipbuilding, the provision of machinery and equipment of artificial silk, woollen and biscuit factories, electricity supply and housing in connection with industrial developments.

In conclusion, I should like to refer to my opening words—the unity of Northern Ireland with Great Britain. Incidents of frequent occurrence show that even yet the absence of any tariff or other restrictions between this part of the United Kingdom and Great Britain is not fully appreciated. It cannot be too clearly emphasised that commerce between Great Britain and ourselves is as free as between England and Scotland and Wales; that the Channel provides the best of highways between us and every part of Great Britain because it is open to all; that our interests—financial, commercial, industrial, social and political—are knit with those of our fellow-countrymen in Great Britain.

GENERAL NOTES.

BRITISH INDUSTRIES FAIR.

EXHIBITORS IN CHEMICALS AND DRUGGISTS SECTION.

The following is a list of exhibitors in the Chemicals and Druggists Sundries section of the British Industries Fair which is to be held in the new and reconstructed Olympia, London, from February 17 to 28 next :—

Albright and Wilson, Ltd., Oldbury; Allen, Frederick, & Sons (Poplar), Ltd., London; Aluminium Plant and Vessel Co., Ltd., London; Association of British Chemical Manufacturers, London; Ayrton, Saunders & Co., Ltd., Liverpool; Barnard's "Mascot" Inhalant Catarrh Cure, London; Beatle Sales, Ltd., London; Beetle Products Co., Ltd., London; Berton, Arthur, Ltd., London; Boake, A., Robert & Co., Ltd., London; Bristow, T. F. & C., Ltd., London; British Chemical Plant Manufacturers' Association, London; British Cyanides Co., Ltd., London; British Drug Houses, Ltd., London; Burgoyne, Burbridge & Co., Ltd., London; Burroughs, Wellcome & Co., London; Bush, W. J. & Co., Ltd., London; Calvert, F. C. & Co., Ltd., Manchester; Chemist and Druggist, The, London; Corfield, Ltd., London; Cussons, Sons, & Co., Ltd., Manchester; Deptford Glassworks, Ltd., London; Dubarry et Cie., Hove; Faudels, Ltd., London; Field & Co., London; Ford, T. B., Ltd., Loudwater; Gas Light and Coke Co., London; General Chemical and Pharmaceutical Co., Ltd., London; General Kaputine Syndicate, Ltd., Manchester; Graesser-Monsanto Chemical Works, Ltd., London; Grossmith, J., & Son, Ltd., London; Heppells, Ltd., London; Hope's Soaps (Chas. Midgley, Ltd.), Manchester; Hopkin and Williams, Ltd., London; Hopkins and Williams (Travancore), Ltd., London; Howards & Sons, Ltd., Ilford; Hulse, F., & Co., Ltd., Woodlesford; Imperial Chemical Industries, Ltd., London; Ingram, J. G., & Son., Ltd., London; Jackson, Ernest & Co., Ltd., Crediton; Johnson & Sons, Manufacturing Chemists, Ltd., London; Jones, W. A.

Ltd., Liverpool; Kerfoot, Thos., & Co., Ltd., Bardsley; Kestner Evaporator and Engineering Co., Ltd., London; Komposill Universal, Ltd., London; Lacco Proprietors, Ltd., London; Lovell, H. S., & Co., London; Macleans, Ltd., London; May & Baker, Ltd., London; Midgley, Charles, Ltd., Manchester; Mond Staffordshire Refining Co., Ltd., London; Morgan Bros. (Publishers, (*Chemist and Druggist*), Ltd., London; Morson, Thos., & Son, Ltd., London; Myosotis, Ltd., London; Northampton Polish Co., Ltd., Northampton; Payszu Soap Co., Ltd., London; Philli Mirano Co., Ltd.; Phil-Sano Co., Ltd., London; Redio Co., Ltd., Kingston-on-Thames; Roberts and Sheppey, London; Scrubb & Co., Ltd., London; Sheffield Stamping Co., London; Solport Bros., Ltd., London; South Metropolitan Gas Co., London; Spencer, Chapman, and Messel, Ltd., London; Swifto Manufacturing Co., Glasgow; Thermos (1925), Ltd., London; Thorium, Ltd., London; Tyrer, Thos., & Co., Ltd., London; Union Jack Paste Co., Seaford; Viscose Development Co., Ltd., Bromley; "Wee-Kura" Powder Co., Knaresborough; Whiffen & Sons, Ltd., London; White, R. F., & Co., Mitcham; Williams (Hounslow), Ltd., Hounslow; Windward Violet Farm, Dawlish; Wright, Layman and Umney, Ltd., London.

SCIENCE AND SHIPPING.

The St. Lawrence River May Always Be Kept Open.

(From a Special Correspondent.)

The importance of chemical science in attacking the problems of to-day has been well illustrated by the success attending the efforts to keep the St. Lawrence River open for a longer period than in the past. It is now even suggested that the time will come when the channel from the sea to Montreal will be kept open the year round, which would entirely change the shipping business of Canada, which now has to look to the Atlantic ports of Halifax and St. John for winter business, or else rely on Portland, New York, and Boston, which is not wholly agreeable to Canada at the present time, when it is searching for new ways to develop its own interests.

This work of improving the St. Lawrence for shipping has been in the hands of Dr. Howard Barnes, of McGill University, Montreal, who declares that he has had no need to have recourse to "black magic" to cause millions of tons of ice to disappear. The mighty forces of Nature are enough, if properly utilised, to keep the Channel to Montreal open throughout the year. Through scientific study of ice formation, and the employment of materials which Science has discovered, this may in future be achieved with a moderate outlay.

The contract which enabled Dr. Barnes to carry on his work was signed by the Canadian Government on January 23, 1929. The first thing necessary was to conduct a survey of the River from Longue Pointe to Sorel to find key places where ice jams formed, backing up the water and causing floods at various points on the South Shore and along the waterfront in Montreal East and below. It was found that at certain places enormous amounts of frazil ice had jammed its way under the surface ice, and had caused such a congestion that the water could not get through quickly enough. As a result the water backed up, thus leading to serious flood conditions.

"Thermite" as an Ice Dissolver.

The survey of the River showed the key positions where dangerous ice formations, sometimes to the depth of 30, 40 or even 50 feet, were occurring. The work was done at those points, relieving the congestion, and the River current did the rest of the work. No attempt was made to destroy the surface ice, but even this was found in the spring to be only half its normal thickness. The cutting action of the unretarded currents had done its work efficiently.

The materials used in destroying ice formation were tons of thermite, calcium chloride and carbide, together with minor quantities of other substances used by Dr. Barnes in the destruction of ice ond preventing its formation. Thermite, Dr. Barnes points out, was not used primarily to melt ice, but to weaken the structure of the formations in such a way that water currents could function. The flowing water actually did the work.

The thermite, a combination of aluminium and iron oxide, when fired by means of electrical apparatus, gave out enormous quantities of heat in comparatively short spaces of time. The great explosive force of the charge, and the released masses of hydrogen gas, together with the effects of pellets of flaming thermite shot in all directions for scores of feet into the surrounding ice, was sufficient to weaken the whole structure of frazil ice, which then gave way. Dangerous congestions were thereby eliminated.

THE VALUE OF SOLITE.

The calcium chloride was used to melt and thus weaken ice on the surface. The carbide when released into the depths of packed frazil ice created immense quantities of acetylene gas, which had a marked effect in loosening, and causing the ultimate destruction, of serious formations of ice. Solite, another substitute used by Dr. Barnes, and one which he believes will be more effective even than thermite, was kept in readiness to be dropped in the form of bombs from airplanes in cases of emergency. But these were not required. Solite has advantage of not having to be ignited, as it ignites itself upon coming into contact with water.

Ice was not so much melted by the heat as by the light of the sun. The heat of the sun melts some ice at the surface of the mass, but this heat is carried off by the escaping water. It is the yellow, green and red rays which, penetrating the mass of ice, cause its ultimate disintegration, says Dr. Barnes. Ice-breakers, ships used to break up ice, were becoming out of date as agents in the destruction of ice, in Dr. Barnes' opinion. Chemical means are far more economical, and chemical substances may be used to co-operate efficiently with the mighty forces of Nature in the destruction of ice in a great river like the St. Lawrence.

Dr. Barnes touched upon the effect that Lake Ontario has on the formation and destruction of ice in the river below. This was one of the most important factors in keeping the channel around and below Montreal clear of ice in the winter months. A great quantity of heat is stored up in the deep waters of Lake Ontario during the summer, which actually lasts throughout the winter. This heat, if conserved by being brought down in a deepened channel of water, so that it does not lose its heat in spreading over a considerable area, will do a great deal to solve all the ice problems on the St. Lawrence below Lake Ontario.

ONTARIO GOLD PRODUCTION.

The Ontario Department of Mines reports that during October the gold mining industry in that Province experienced its second best month, production being valued at $3,071,591, as compared with the previous record total of $3,400,463 attained in December, 1927. The destruction by fire on October 28 of the Dome mill is, however, expected to decrease the output of gold by more than $300,000 per month in the near future.

During October, producting mines in order of output were as follolws :—

Porcupine : (8) Hollinger, McIntyre, Dome, Vipond, Coniaurum, March, West Dome, and Porcupine United.

Kirkland Lake : (6) Lake Shore, Teck-Hughes, Wright-Hargreaves, Sylvanite, Kirkland Lake Gold, and Barry- Hollinger.

The gold output mentioned above was derived from 346,691 tons of ore milled, a considerable reduction as compared with the total for October, 1928, amounting to 372,349 tons, when the bullion return was $2,798,427, it being evident therefore that ore of higher metal content was being brought up.

The total production in the Province during the ten months ended October 31 was $27,783,583, as compared with $26,546,913 for the corresponding period of 1928, the quantity of ore milled declining from 3,512,510 tons to 3,360,098 tons.

During the month 249,108 tons of ore were milled declining from 3,512,510 tons to 3,360,098 tons.

During the month 249,108 tons of ore were milled in the Porcupine field with a bullion recovery valued at $1,921,922, a satisfactory record as compared with that for October, 1928, when 282,852 tons of ore were milled with a bullion recovery valued at $1,698,122.

In the Kirkland Lake field the quantity of ore milled rose during the month from 89,997 tons to 97,583 tons, and there was a rise in bullion recovery from $1,100,305 to $1,148,728.

TWENTIETH ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY.

The Twentieth Annual Exhibition of the Physical and Optical Societies is to be held on Tuesday, Wednesday and Thursday, January 7, 8 and 9, 1930, at the Imperial College of Science, Imperial Institute Road, South Kensington, and will be open in the afternoon from 3 p.m. to 6 p.m., and in the evening from 7 p.m. to 10 p.m.

Over eighty firms have accepted the invitation to exhibit in the Trade Section at this Exhibition, and in addition a group of research and experimental exhibits is being arranged, which will be shown by Fellows of the Societies and others, and a number of research laboratories and other institutions. Some interesting historical exhibits will also be included.

The Discourses, with experiments, which will be given at 8 p.m., on each evening, are as follows :—

On January 7—The Right Hon. Lord Rayleigh, M.A., Sc.D., F.R.S.: "Iridescent Colours in Nature from the Standpoint of Physical Optics."

On January 8.—Mr. S. G. Brown, M.I.E.E., F.Inst.P., F.R.S.: "Gyro Compasses for Gun-Fire Control."

On January 9.—Sir Ambrose Fleming, M.A., D.Sc., F.R.S.: "Television, Present and Future."

With the object of encouraging Craftsmanship in the Scientific Instrument Trade, a section of the Exhibition is to be devoted to the work of Apprentices and Learners, in competition, and the Councils of the Physical Society and Optical Society have appointed the following judges.

Dr. C. V. Drysdale, Professor A. F. C. Pollard, Sir Thomas Stanton, Mr. William Taylor.

We understand that invitations to the Exhibition have been sent to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Royal Aeronautical Society, the Royal Meterological Society, the Faraday Society, and a number of other societies and bodies. As in previous years, members of these societies should apply for tickets to their Secretaries. Others may obtain tickets on application to the Secretary, the Physical and Optical Societies, 1, Lowther Gardens, Exhibition Road, London, S.W.7. Tickets are required only on January 7 and 8. Admission on the third day, January 9, will be without ticket.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

Friday, December 13.

Papers read:—

Apparatus for Determining the Specific Heat of a Material in Powder Form. By J. H. AWBERY, B.A., B.Sc., AND EZER GRIFFITHS, D.Sc., F.R.S., Physics Department, The National Physical Laboratory, Teddington, Middlesex.

A calorimeter suitable for heavy powdered materials, such as dry clay, was described. It utilises the electrical method, and embodies a special form of stirrer suitable for these materials.

The Determination of the Parameters in an Empirical Formula. By W. EDWARDS DEMING, Ph.D., Physicist, Bureau of Chemistry and Soils, Washington, D.C.

The author reviewed the method of least squares and gave reasons for recalling some cautions regarding its use that were mentioned by Stewart and Uhler several years ago. Examples were worked out to illustrate the discussion. The method recently mentioned by Awbery was compared with those of least squares, and zera sum, from the practical point of view. Judging from the few examples given, the method of zero sum appears to be the quickest and its results to be well in accord with common sense judgment. The amount of computation involved in the application of the various methods must be viewed in the light of the short cuts and elaborate calculating machines now available, since these may lighten the labour for one method more than for another. Attention is called to the fact that the method recently expounded by Awbery is the one given by Cauchy in 1847.

The J-Phenomenon in X-rays. By N. S. ALEXANDER, M.Sc., National Research College, New Zealand.

A series of experiments has been carried out with the view of repeating as far as possible the work of Barkla and others on the *J*-phenomenon, and, considered in conjunction with the work of Dunbar, Worsnop, and Gaertner, they suggest that it has no real existence as an X-ray absorption effect.

Some apparatus for use in a hospital radium service was exhibited by Prof. F. Ll. Hopwood, D.Sc.

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on December 4, the President, Mr. Edward Hinks, being in the Chair.

Certificates were read for the first time in favour of Ronald Gibert Baskett, B.Sc., Hugh Charles Loudan Bloxam, F.I.C., Claud McClellan Bottomley, B.Sc., John Butler, B.Sc., F.I.C., Robert Ellison, A.M.C.T., George Noel Grinling, F.I.C., Albert Houlbrooke, M.Sc., A.I.C., Philip Henry Jones, F.I.C., Raymond Mallinder, Sydney Norman Herbert Stothart, B.Sc., Ph.D., A.I.C., Hubert Threadgold, B.Sc., A.I.C.

Certificates were read for the second time in favour of:— Noel Lionel Allport, A.I.C., James Gilbert Lunt, B.Sc., A.I.C., Fred Morris, F.I.C., Albert William Peters, Juda Hirsch Quastel, D.Sc., Ph.D., A.R.C.S., A.I.C., and Joseph Harold Totton, B.A., B.Sc., F.I.C.

The following were elected Members of the Society: Alfred George Avent, A.I.C., William Rhys Davies, F.I.C., Ernest Roadley Dovey, A.R.C.Sc., F.I.C., James

Gray, F.I.C., James Henderson, B.Sc., A.I.C., Claude Alexander Scarlett, B.Sc., A.K.C., A.I.C., Percy Arthur William Self, B.Sc., F.I.C., Thomas Brooks Smith, B.Sc., A.R.C.S.

Professor A. P. Laurie gave a lecture on *The Methods of Examining Pictures.*

He outlined the composition of the different pigments used for old illuminated MSS. and oil paintings, and it was shown how the identification of these enabled the approximate date of an ancient work of art to be ascertained. The methods of sampling the pigments on a painting by means of a micro-borer and their examination by means of a microscope polariscope were described, and a summary of the micro-chemical tests which had been found most suitable for the various classes of pigments was given. The conclusions to be drawn from chemical and optical data were illustrated by lantern slides of photographs in colour of historic paintings and illuminated missals. The use of X-ray photography and ultra-violet rays for the examination of pictures and the detection of alterations or forgeries was discussed and illustrated, and it was shown how an examination of the brush strokes in an oil painting, considered in conjunction with the chemical and optical properties of the pigments, enabled a judgment to be formed as to whether the whole work had been produced in one studio and at the same period.

The following papers were read and discussed :—

The Quantitative Analysis of Mixtures of Nickel and Cobalt. By S. Glasstone, D.Sc., and J. C. Speakman.

Electrometric titrations of nickel and cobalt solutions with potassium cyanide, with the use of nickel and cobalt indicator-electrodes, respectively, have established the soundness of the theoretical basis of the Rupp and Pfennig method of determining these metals. It is applicable to mixtures and to more dilute solutions than have previouslybeen used. A modified iodimetric method has also been developed for determining small amounts of cobalt in the presence of nickel.

The Changes with Age of the Hydrogen Ion Concentration of Egg White and Egg Yolk. By J. C. Baird, B.Sc., A.I.C., and J. H. Prentice, B.Sc., A.I.C.

Determinations of hydrogen ion concentration by means of a quinhydrone electrode indicated that the normal pH value of fresh egg white is approximately 8.6, and that there is a rapid rise in the course of the first week of storage to a level of about pH 9.0, at which figure the reaction remains fairly constant. The fresh yolk has a reaction of approximately pH 6.0, which in the course of 10 weeks rises to about 6.2. Since commercial eggs are several days old at least, the method cannot be used to determine the age of such eggs. The refractive index of the egg white is constant at about 1.360.

THE BRITISH ASSOCIATION OF CHEMISTS.

Annual General Meeting and Dinner.

The Annual General Meeting was held at the Manchester College of Technology on November 30, Mr. F. Scholefield, President, in the chair.

Mr. W. H. Woodcock (Hon. Treasurer) reported a small balance on the credit side. It was satisfactory to note that subscriptions had risen substantially, and that arrears had fallen since few remained to be collected. This was a satisfactory position.

The position of the Unemployment Benefit was very sound. The reserves had considerably increased during the past year, and the Unemployment Committee were to consider the increase of benefit.

Mr. Foster expressed the view that a reduction in unit subscription and an increase in benefit would be welcomed by members. He proposed a resolution requesting the Unemployment Special Purposes Committee to consider the question. The resolution was carried.

The Association and the Ministry of Labour.

Mr. Rhodes, in submitting the Annual Report, alluded to the increase of membership which was larger than for many years past. The Unemployment Fund had paid out £504 in benefit during the year, but in spite of this heavy call on it, the fund was in a thoroughly satisfactory position. The importance of the collaboration of the Ministry of Labour with the Association could not be exaggerated. The Ministry recognised the Association as the appropriate body to deal with questions of the employment of chemists.

The President paid a tribute to Mr. W. E. Kay. Mr. Scholefield said Mr. Kay was well known in Manchester for his great ability as a chemist, and for his sound judgment and experience. He was among the original members of the Association.

THE PRESIDENT'S ADDRESS.

In the course of his address, Mr. Scholefield drew attention to the increasing tendency in every direction to large scale organisation in industry. It was an example that sooner or later the profession of chemistry would be obliged to follow. That was to say to organise comprehensively on the lines of the professions of law and medicine. The position of the individual chemist was quite different to that occupied by him even twenty years ago. It had to be recognised that industrial changes involved a necessary development along the same lines in professional organisation. The professional group would have to deal with the industrial group.

The time was coming when the chemist would not have to consider the company he would enter bu thow he was to enter the service of *the* company. Imperial Chemical Industries, Lever Bros., The Margarine Trust, were good examples of the trend of events. Amalgamation begun on these lines would not stop there. It was only the beginning of larger and larger associations and combines. This would mean the restriction in movement of the chemist and a change in his value as an individual.

This was not necessarily a bad thing. There was no indication, rather the contrary, that large industrial organisations would use their power oppressively. But it had to be recognised that the position called for a similar rationalisation on the part of the professional worker, or he must undoubtedly suffer injury. The object of such organisation was primarily, of course, economic. There were increased opportunities for the profession working as an organised unit which could not be grasped by individuals. The loss of those opportunities would be a very serious matter for the profession and for industry.

In proposing the toast of "The Association" at the Annual Dinner, Prof. G. T. Morgan commented upon the satisfactory position of the Association. The condition of the general fund and that of the unemployment fund showed that the Association was making good progress, and he was glad to note the satisfactory increase in membership. The work that the Association was doing in the direction indicated in the Annual Report proved that it merited the increased support it was receiving.

Replying, Mr. W. H. Woodcock said that it was a very great pleasure to welcome Prof. Morgan and to hear him as a Past President pay so handsome a tribute to the society. Quite apart from the financial position the progress of the society had been considerable. Prof. Morgan had said something about what a tight hand he kept on the purse strings; that was the unpleasant duty of all Treasurers.

Mr. Henry T. F. Rhodes, editor of the *Chemical Practitioner*, paid a tribute to the guests. He said that guests were invited because they were friends and that friends were necessary to all organisations, professional or otherwise. In the name of the Council he congratulated Dr. Levinstein on his election as President of the Society of Chemical Industry.

Principal B. Mouat Jones replied.

In proposing "'Kindred Societies," Dr. H. Levinstein, President of the Society of Chemical Industry, said that it was a great pleasure to him as a Past President of the Association to note its steady advancement. In spite of the fact that progress was slow there was a movement to organise the societies in such a way that the burden of subscriptions for the numerous chemical journals could be lightened.

There was also the possibility that at least some of the societies would find a common headquarters in one building. These things would bring about closer co-opedation among the societies, an end towards which all societies were working.

Mr. A. W. Knapp replied.

CHEMICAL SOCIETY'S LIBRARY.

The Library of the Chemical Society (Burlington House, London, W.1.), will be closed for the Christmas Holidays from Monday, 23 December at 9 p.m., until Monday, 30 December at 10 a.m.

NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

CORRESPONDENCE.

(*To the Editor of the* CHEMICAL NEWS.)

WRONG WAYS TO SMOKE ABATEMENT.

Sir,—Is there not a danger that our local authorities, in their praiseworthy zeal for the abatement of domestic smoke, may prescribe remedies worse than the disease? I have in mind the benediction given by the Minister of Health to a London housing scheme which includes some eight or nine hundred " all-electric " houses from which the domestic chimney has been omitted.

I do not desire to dispute the virtue of electricity as a heating agent which does not produce fumes, but, speaking as one who has devoted some years of study to the practical side of this question, I doubt the wisdom of assuming that, for the whole period of the life of these houses, the substitution of an open grid ventilator for the domestic chimney will suffice. It is, I think, admitted by architects, building surveyors, and public health officials that normally the open fire, or the gas fire connected with an adequate flue, is the best means of ensuring that constant movement of air which is so necessary in a heated room. The omission of the domestic chimney without replacement by flues of reasonable dimensions presupposes that the grid ventilator will always function adequately and never be subject to accidental or deliberate obstruction. But this assumption is not borne out by experience, and even if it were, it is the wildest optimist to suggest that a grid can take the place of a chimney as an agent for the proper and constant change of the air in a room. Many public health officials will entertain grave fears regarding the conditions that are certain to be produced in houses from which the surest means of ventilation has been omitted.

From the public point of view, it is not, I think, unfair to challenge the propriety of a local authority depriving its tenants of all choice in the matter of the heating agent to be employed within the home. The time may come when the occupier will rebel against being compelled to sit over an electric radiator, and will demand the open grate or gas fire, and unless the use of combustible fuels is absolutely prohibited, it may well happen that what are intended to be the most up-to-date houses will become the most unhealthy.

Local authorities who contemplate fostering their electricity undertakings in their housing schemes should, in my view, at least give the tenant the choice of a gas grate or a smokeless fuel fire in the living room.

I have lived in a room without a chimney and with electric heating, and suffered in health accordingly. I am now responsible for building some 250 houses, and have made it the first and unbreakable rule that at least three out of four rooms, whether living rooms or bedrooms, shall have a chimney, whatever form of heating may occupy the hearth.

I am, Sir, etc.,

LAWRENCE WEAVER.

110, St. Martin's Lane,
London.
December 4, 1929.

PHYSICS IN RELATION TO THE UTILISATION OF FUEL.

By DR. C. H. LANDER, C.B.E.

A lecture on " Physics in Relation to the Utilisation of Fuel " was delivered on November 27 by Dr. C. H. Lander, C.B.E., Director of Fuel Research, under the auspices of the Institute of Physics. Dr. Lander said that in every stage from the getting of coal to the efficient utilisation of its heat of combustion, physical as well as chemical considerations were of the greatest significance. During recent years there had been a widespread development of physical instruments for the measurement of temperature, pressure, velocity, etc., and their more general adoption had resulted in greatly improved control of processes of combustion and heat transfer.

Fuel problems could be conveniently divided into three broad sections, firstly, the preparation and specification of the fuel, secondly, its treatment prior to combustion and thirdly, fuel utilisation.

One of the most difficult problems in the specification of coal was that of taking samples for analysis. It was clearly essential that the sample should be truly representative of the whole within a prescribed degree of accuracy, and there was no point in carrying out the analysis more accurately than the sampling. The larger the sample, the more accurate it was likely to be, but short of taking the whole bulk no method of sampling, however carefully chosen, could be relied upon to give perfect accuracy, considerations of probability and probable error entering inevitably into the question; and even though the sampling were carried out in the fairest manner possible so as to exclude all possible segregation of im

purity the sample could only be regarded as probably accurate within certain limits, depending upon such factors as the size of the sample, the size of the individual lumps of which it was composed, the distribution of impurity, etc. Methods of sampling had in the past been extremely crude, and although some progress had now been made in the direction of placing the subject on a more scientific basis, a great deal still remained to be done.

Coal was commonly classified upon considerations of its volatile content, flaming characteristics or ultimate chemical analysis, but scientific workers were gradually coming to realise the important bearing of the actual nature of the coal substance, including its physical structure, upon fuel problems. The aid of the microscope for instance had recently been widely enlisted both in the examination and classification of coal, and in the identification and correlation of coal seams. Two methods were now commonly employed; either a thin section might be prepared for examination by transmitted light, or a surface of the specimen might be polished, and, if necessary, etched, for examination by reflected light.

As seen under the microscope, specimens prepared by the two methods differed very considerably. In thin sections the various entities constituting the coal were seen in colours ranging from pale yellow through orange and red to an opaque black. Spore-exines and fragments of cuticle, usually pale yellow in section, stood out vividly against a darker background, in which might be seen traces of cell-structure. In the absence, however, of marked colour contrast between, for example, the cell-walls of a plant fragment and the in-filling material, visibility of structure would depend upon difference in the refractive indices—differences that were small and would require special illumination to reveal them.

A polished surface, on the other hand, might be regarded as a section of such extreme thinness that even the slight modification in thickness caused by etching would by comparison be very marked, enabling the finest details to be seen. By the method of polishing and etching Seyler had been able to show, sometimes in a single plant fragment, various stages by which structures might pass into a nebulous state, becoming obscure and finally lost, and had thus been able to explain peculiar structures the nature of which was previously conjectural. The method had the advantage that a plant fragment could be viewed in three planes at right angles.

Microscopical methods also afforded assistance in the identification of coal seams, since certain distinctive types of megaspore, or the relative concentrations of different types at different horizons, sometimes characterised a seam.

The application of X-rays to the examination of the ash of coal, which was first suggested many years ago, had recently been developed in this country by Kemp, and was yielding useful results, the method depending upon the difference in transparency to X-rays of the organic coal substance and the inorganic ash constituents. From the results so far obtained, it seemed probable that with improved technique the method should provide a rapid means of determining the distribution, nature and amount of the ash in coal, which had an important bearing upon problems of coal washing.

Attempts had also been made to gain further information of the structure of coal or coke by means of an X-ray spectrometer. This work apparently demonstrated the presence of graphite in each of the types of coke examined; moreover, when four widely different varieties of coke were investigated a distinct parallelism was observed between the size of the graphite crystals as indicated by the shapes of the resultant reflection curves and the reactivity of the coke, as determined by the Fuel Research Station method, the most reactive coke apparently being made up of the smallest crystals and *vice versa*.

A comparatively undeveloped subject was the physics of the furnace. This was no doubt partly due to the complicated nature of the problems involved. From a physical point of view the problems were complicated chiefly because they involved the transfer of heat from a moving medium. In a completely enclosed furnace, such as the electric furnace, the problems were very much simplified. The fuel fired furnace, however, was a much more difficult problem on account of the moving gases. It had been increasingly realised during recent years that radiation from furnace gases was probably a factor of great importance.

Those concerned with heat problems have cause to look with envy upon the results obtained in aeronautics through the medium of small scale 'model' experiments. There was no equivalent in heat to the wind tunnel in aerodynamical research. Mathematically this was primarilly due to the much greater number of variable factors

which entered into heat problems. Instead of one Reynold's nnmber as in aeronautics, the heat physicist was faced with several 'criteria,' which in fact it might be impossible to satisfy concurrently; model experiments so designed as to yield information which could be directly correlated with full scale working were therefore in general not feasible where heat flow was concerned. In any type of fuel fired furnace, for instance, in addition to the flow of the combustion gases, heat interchange by conduction, forced and natural convection, and radiation were taking place. These together produced conditions of such complexity that the heat engineer or physicist was nearly always forced to conduct his experiments on the full scale, involving not only greater expense, time and labour, but also greatly increased difficulty in controlling working conditions, and in interpreting the results obtained. Experimenters had indeed been accustomed to express their results in empirical formulæ which went no further than fitting the limited range of conditions covered. The disadvantage of such a procedure was obvious, since it precluded the application of the results to conditions differing even only slightly from those of the test, and rendered comparison with the work of other investigators extremely difficult, if not altogether impossible.

Despite the great complexity of industrial heat problems, the analytical methods of attack upon which pure physics had been built up, although sometimes difficult to apply, led further than empirical ones, since they assisted in a wider and fuller understanding of the fundamental principles involved, which should in time tend to a more rational design of furnaces or other heating appliances.

NOTICES OF BOOKS.

Anorganische Chemie. By PROF. FRITZ EPHRAIM. Fourth enlarged Edition. Pp. xii + 809. Dresden: Theodor Steinkopff. 1929. Price 28 marks.

It is a noteworthy tribute to Prof. Ephraim (of Berne University) that his interesting and stimulating Textbook of Inorganic Chemistry has reached a fourth edition in the short space of seven years. By far the most importance is attached to a thorough study of the commoner non-metals, the chemistry of which is very fully considered whilst those sections relating to the metals are rather brief, although additions have been made in the present edition to these parts. The work has been brought up to date by the inclusion of all relevant recent discoveries and modern theoretical views. Thus, much new matter is incorporated in the chapters dealing with the structure of the atom and in a description of new X-ray technique.

Several pages have been added to give an adequate account of the chemistry of Hafnium, Illinium and the Congeners of Manganese. As far as these last are concerned, however, Prof. Ephraim has only referred to the work of German investigators and although he mentions their later work he only gives the early references

The author is also inconsistent in the use of symbols. Thus, argon is sometimes A and sometimes Ar, Y is, however, always given for yttrium. This is regrettable, for Yt would lead to less confusion. Indeed, it would be well, in the reviewer's opinion, if the letters A, X, Y and Z were never used as chemical symbols.

It has recently become the fashion among reviewers to comment on the Indexes. Both the Name and Subject Indexes of this book are extensive, but the first reference sought could not be traced to the page given (Jorissen, p. 337) nor to any variation of the digits. Doubtless other trivial defects might be cited, but Prof. Ephraim's volume stands out as one of the finest German Textbooks of the day.

J. G. F. D.

RADIOACTIVITY.

Report of Committee on X-Rays and Radioactivity National Research Council. By A. F. KOVARIK AND L. W. MCKEEHAN.

Prominence has recently been given to the various phenomena associated with Radioactivity in which branch of physico-chemical science there has been a a steady stream of investigations ever since the phenomenon was observed at the close of last century. In 1925 the U.S. National Research Council issued an important *Bulletin* on the subject and this has now been re-issued in a revised form, corrected, and with an inclusive bibliography of all the important works and articles on Radioactivity.

Recent experimental work has, during the last few years, had special bearing upon the time order of the β- and γ-rays; the half-value periods of some of the radioactive elements and the existence of some of the long-range α-particles. Among the matters unsolved, but which are under investigation, are the origin of proto-actinium; nuclear structure; cosmic rays; artificial disintegration and also the age of radioactive minerals.

•On the question of nomenclature it is pointed out on page 6 of the *Bulletin* that the designation of radioactive substances has undergone many changes and bears the evidences of its irregular history in the arbitrary character of the names and symbols used. Serious workers have recently made attempts to systematise the nomenclature and these authors assist in the same direction by giving standard tables and terminology.

All aspects of the subject have been covered and the effects of radioactive radiations upon matter, nuclear disintegration, secondary radiation and the application of radioactive phenomena are discussed at the end of this *Bulletin* (No. 51, pp. viii + 203; price $2.50) which is one of those issued by the National Research Council, Washington, D.C.

At the end there is also a list of the other *Bulletins* that have been published by this Council and among them may be noted :

No. 47, *Classified List of Published Bibliographies in Physics*, and

Nos. 50 and 71, *Bibliographies on Chemistry and Chemical Technology*.

J. G. F. D.

THE SULPHOALUMINATES OF CALCIUM.

By William Lerch, F. W. Ashton, and R. H. Bogue.

(*U. S. Bureau of Standards.*)

Two calcium sulphoaluminates have been prepared and their compositions and optical characteristics determined. One of these, having the composition $3CaO.Al_2O_3.3CaSO_4.31H_2O$, is relatively stable in aqueous solutions but is decomposed by solutions of magnesium salts and of carbonates. The other, having the composition $3CaO.Al_2O_3.CaSO_4.12H_2O$, is relatively unstable except in high concentration of hydroxyl ion. It is readily converted to the high sulphate form in aqueous solutions but is decomposed by magnesium salts and carbonates. In sulphate solutions the high sulphate form may be produced, but in the presence of a slight excess of magnesium salts or carbonates neither of the sulphoaluminates can continue to exist. In these cases the less soluble magnesium hydroxide and calcium carbonate, respectively, are formed.

Forthcoming Events.

ROYAL INSTITUTION.

CHRISTMAS LECTURES ADAPTED TO A JUVENILE AUDITORY.

In the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2., at 3 p.m., by S. R. K. Glanville, M.A., on "How Things Were Done in Ancient Egypt."

Saturday, December 28.—"The Elementary Use of Nature."
Tuesday, December 31. — "Making a Home."
Thursday, January 2.—"Building in Stone."
Saturday, January 4, 1930.—"Boats and Furniture."
Tuesday, January 7, 1930.—"The Workshops."
Thursday, January 9, 1930.—"Hieroglyphs."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

35,805.—Boot's Pure Drug Co., Ltd., and Easson, A. P. T.—Manufacture of amidines. November 22.
35,273.—I. G. Farbenindustrie Akt.-Ges. —Production of chemically pure phosphoric acid. November 18.
35,178.—I. G. Farbenindustrie Akt.-Ges. —Production of hydrogen, etc. November 18.
35,257.—I. G. Farbenindustrie Akt.-Ges. Manufacture of diazo-dyestuffs insoluble in water. November 18.
35,488.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of chloro derivatives of the anthraquinone - acridone series. November 20.

Specifications Published.

321,703.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture and production of vat dyestuffs.
295,594.—Soc. of Chemical Industry in Basle.—Manufacture of dyestuffs containing chromium.

295,694.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of arylcarboxylic acid, amido - ortho - thioglycollic acids, and hydroxythionaphthenes.

209,445.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of alkali iodates and its application to the manufaceure of oxygen.

321,738.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of phenylcarboxylic acid compounds.

Abstract Published.

320,125.—Nitric Acid.—Johnson, J. Y., 47, Lincoln's Inn Fields, London.—(I. G. Farbenindustrie Akt.-Ges.; Frankfort-on-Main, Germany.

Concentrated nitric acid is prepared from dilute nitric acid by extraction with liquid nitrogen peroxide at 30-60° C. in a closed vessel whereby considerable pressure is attained. The upper layer of nitrogen peroxide is removed and may be distilled to obtain concentrated nitric acid, or may be cooled to form two layers, the lower one containing the bulk of the nitric acid and the upper one mainly nitrogen peroxide which may be used again for extraction. Waste acids such as those obtained in nitrating cellulose or in making dyes or intermediates may be treated.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His

OMNADIN.

503,284.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes.—I. G. Farbenindustrie Aktiengesellschaft, Mainzer Landstrasse 28, Frankfort-on-Main, Germany, and Bayer Products, Ltd., 19, St. Dunstan's Hill, London, E.C.3. November 27.

LAVENE.

506,837.—All goods in class 2 which includes chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—Cooper McDougall & Robertson, Ltd., Chemical Works, Ravens Lane, Berkhampsted, Hertfordshire. Nov.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,

The Chemical News,

Offices : Merton House, Salisbury Square. London, E.C.4.

TECHNICAL TRANSLATIONS.

Translations from and into French or German undertaken by a competent linguist. Charges moderate. Enquiries invited.—J. L. c/o *Chemical News.*

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

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No. 3123, Vol. 120; dated April 16, 1920. Good price, and postage, paid.

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THE CHEMICAL NEWS

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A NEW CONCEPTION OF RELATIVE CONFIGURATION.

By CHARLES EDMUND WOOD AND SYDNEY DIGGARY NICHOLAS.

(*University of Birmingham.*)

INTRODUCTORY.

Two notable workers in the field of optical activity were Winther and Walden, and taking the year 1905 as a starting point, a discussion arose in that year between these two workers as to what were the most advantageous lines of future research in optical activity. Winther stated (*Zeitschr. physikal Chem.*, 1905, LII, 200) that much useless work would be done if one continued with old traditional methods instead of seeking new. The old traditional methods were :— rotation for a single wave length, namely, sodium light and rotation for a single temperature, generally room temperature.

Winther therefore advocated rotations for different wave lengths, *i.e.*, rotatory dispersion and rotation for different temperatures, *i.e.*, temperature rotation. His reasons were that characteristic maxima remained undetected thus preventing recognition of family relationship between compounds, further that the dispersion curves obtained for different temperatures formed a family of curves.

Walden, who had previously investigated the dispersion of esters of ricinoleic acid (*Ber.*, 1903, (1), XXXVI, 781) replied (*Zeitschr. physikal Chem.*, 1906, LV, 1) to Winther's criticism by recording polarimetric measurements of a large number of compounds *for light of different colours* at temperatures 20° and 100° C.

In this way was opened up a field more promising for the study of the relationship between rotatory dispersion and chemical constitution.

Considering the development of a mathematical expression for representing dispersion curves, Drude's work is outstanding. In deducing his equation he modified the fundamental Maxwell electro-magnetic equations in accordance with the assumption that the electrons are constrained by unsymmetrical molecular structure to move in helices instead of straight lines; further he showed the intimate connection between dispersion, rotatory dispersion and absorption (*Optics*, Drude, *compare also Handbuch der Physik.*, Winkelmann, *Optik. Band*, VI, 1334). Voigt has also shown what form of electro-magnetic equations must hold in an active medium in order to produce rotation.

Drude verified his formula by reference to quartz and gave an explanation of anomalous rotatory dispersion. He was the first to deduce an equation having definite *theoretical significance*. The equations of Biot and Boltzmann were empirical, no active absorption bands being considered.

In 1912 Lowry (*Phil. Trans.*, 1913, A.CCXII, 261) determined the rotatory dispersion of quartz accurately and secured concordance between observed and calculated values by means of a Drude equation.

Next (*Trans. Far. Soc.*, 1914, x, 57) this author applied the equation to diethyl tartrate successfully and established rotatory dispersion on a quantitative basis. Thus the investigation of quartz led to quantitative measurement of the rotatory dispersion of organic compounds and the year 1914 marks an important advance in the field of optical activity.

Apart from this quantitative development and considering the achievements obtained by the use of monochromatic, *i.e.*, sodium light only (Frankland, *Trans. Far. Soc.*, 1914, x, 92), the actual use made of dispersion data has been disappointing and its significance not realised. But anomalous rotatory dispersion has a definite significance with which this paper is about to deal.

THE DRUDE EQUATION.

Consider its application to compounds possessing anomaly. The Drude equation in its most general form is

$$\alpha \text{ (rotation)} = \sum K_n/\lambda^2 - \lambda^2_n$$

K_1, K_2...... are rotational constants.

λ_1, λ_2......λ_n, are wave lengths corresponding to absorption bands which have a fundamental influence on the dispersion.

λ is the variable wave length of the monochromatic light employed.

For substances possessing potential or visual anomaly the equation reduces to two terms :

$$\alpha = K_1/\lambda^2 - \lambda^2_1 - K_2/\lambda^2 - \lambda^2_2$$

High Frequency Term. Low Frequency Term.

K_1 and K_2 as before are rotational constants, K_2 being in this case negative. λ_1 is an absorption band in the remote ultra violet. λ_2 is an absorption band in the near ultra-violet. Since the frequency is the reciprocal of the wave length, the first term is the high frequency term, the second term is the low frequency term.

There are two components each contributing rotation in the visible spectrum, the high frequency term being a positive term contributes positive rotations, the low frequency term being negative, negative rotations. The resultant effect whether positive or negative depends on the relative values of K_1 and K_2. Figs. 1 and 2 correspond to the cases of $K_1 > K_2$ and $K_1 < K_2$, the former representing visual, the later potential anomaly.

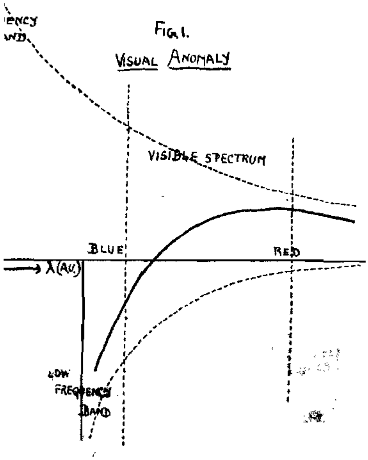


FIG. 1. VISUAL ANOMALY

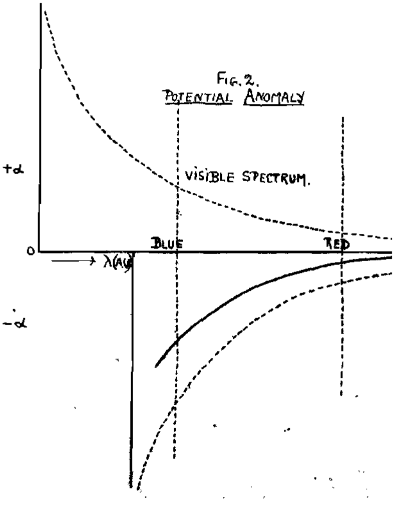
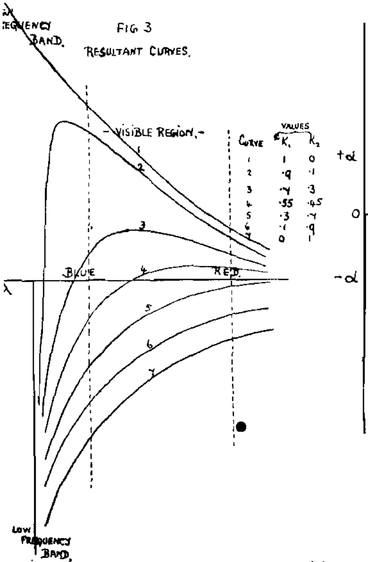


FIG. 2. POTENTIAL ANOMALY

Considering a family of resultant curves (Fig. 8) (after Lowry, *Trans. Chem. Soc.*, 1915, CVII, 1200) which have been obtained from the above two-term Drude equation by changing the ratio of K_1 and K_2 and maintaining the absorption bands at constant values the following points are important :—



(*a*) Curve 1 shows simplicity in positive region and is represented by a single term.

(*b*) Curve 2 is difficult to distinguish from Curve 1 in the visible region but is potentially anomalous.

(*c*) Curves 3 and 4 show visual anomaly.

(*d*) Curves 5 and 6 show potential anomaly.

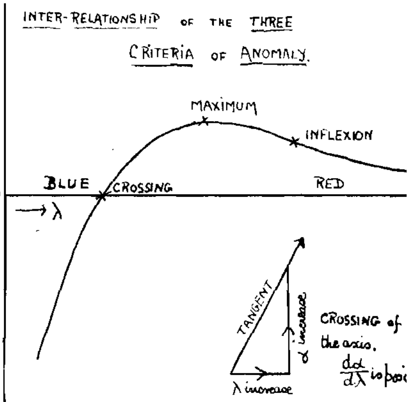
(*e*) Curve 7 shows simplicity in negative region.

(*f*) In the absence of an infra red term all the dispersion curves ultimately become asymptotic to the zero axis. When $K_1 > K_2$ the curves become asymptotic to it in the positive region. When $K_1 = K_2$ or $K_1 < K_2$ the curves never cross the zero axis and become asymptotic to it in the negative region.

Considering a single curve showing visual anomaly it exhibits frequently, inflexion, maximum and crossing of the axis. In the Fig. given below $d\alpha/d\lambda$ is positive at crossing the axis.

The inflexion and the maximum are confined to the positive region. These three characteristics are inter-related so that a

FIG 4



dispersion curve even if it exhibits in the visible region only one of these three characteristics is definitely anomalous. (Lowry, *Trans. Chem. Soc.*, 1915, CVII, 1197; Chapman, *Annual Reports, Chem. Soc.*, 1914, 18.)

To identify a compound as potentially anomalous it would be necessary to analyse the constant of the high frequency term be expressed by a two-term Drude equation, the curve and show that its dispersion can being positive and the constant of the low frequency term being negative. The reverse phenomenon is known. When the high frequency term is negative and the low frequency term is positive a family of curves is obtained reverse to those given in Fig. 8. The anomaly is confined to the negative region and the crossing of the axis $d\alpha/d\lambda$ in this case is negative.

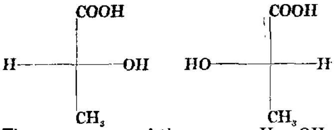
This restriction of anomaly either entirely to the positive or the negative region is significant. No compound is known exhibiting anomaly in both regions. A survey of the extensive data available in the literature reveals many cases of anomaly

either in the positive or negative region. (For example, see Wood and Nicholas, *Trans. Chem. Soc.*, 1928, 1671, etc., also Liquier, *Ann. de Phys.*, 10 ser., 7-8, 1927, 193) but no explanation of this restriction has been attempted.

Before attempting an explanation it is necessary to consider briefly relative configuration.

The Inter-Relationship of the Generic and Empirical Methods for Deducing Relative Configuration.

All optically active compounds can exist in two enantiomorphic forms. In the case of the α-hydroxy acids these are designated " d " and " l ". The " d " and " l " space formulæ for lactic acid being represented by convention by the plane projections

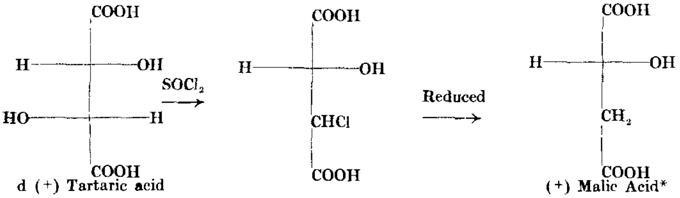


The arrangement of the groups -H, -OH, -COOH round the asymmetric centre in the " d " acid is assumed clockwise, in the " l " acid anti-clockwise. Since compounds of " d " configuration may be either dextro- or levo-rotatory and conversely for compounds of " l " configuration the following convention has been followed :—

d (+) *Tartaric Acid, conversely* l (-) Tartaric Acid.

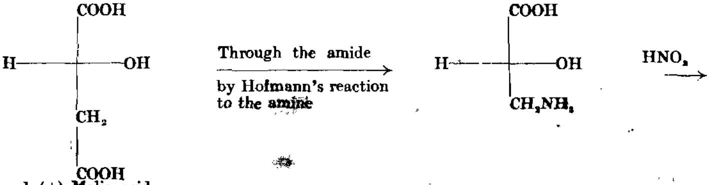
d (-) Lactic Acid, conversely l (+) Lactic Acid.

Let us consider an illustrative chemical method for determining the configuration of an unknown acid (Freudenberg and Brauns, *Ber.*, 1922 (2) LV, 1339).



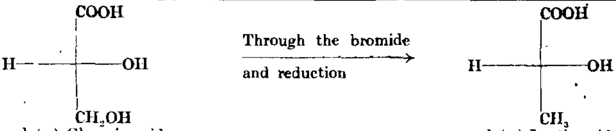
d (+) Tartaric acid — (+) Malic Acid*

which is configuratively related to d(+) tartaric acid inasmuch as three groups in each are superposable, that is, the correspondence of -H, -OH, -COOH in the two acids has been proved. Proceeding further,



d (+) Malic acid

* Brenner, *Ber.*, 1875, VIII, 1594, reduced d(+) tartaric acid with hydriodic acid to *d*(+) malic acid but the yield was small and the possibility of a Walden inversion was not excluded from the reaction.



d (-) Glyceric acid — d (-) Lactic acid

(To be continued.)

LEAD AND ZINC SITUATION IN CANADA.

By Arthur Buisson.
(Canadian Department of Mines.)

The large annual increase in the Canadian production of lead and zinc during the last six years has been mainly due to the successful development of the Sullivan mine of the Consolidated Mining and Smelting Company of Canada at Kimberley, British Columbia. Additional production is anticipated in the near future from important discoveries in various parts of the Dominion, and active development is under way at the Flin Flon and the Sherritt-Gordon copper-zinc properties in Northern Manitoba; at the Errington mine, near Sudbury; Ontario, where the ore is copper-zinc-lead with values in gold and silver; at the Horne, the Waite and the Aldermac mines of Noranda Mines, Limited, and the Amulet and Abana mines, all in Western Quebec, where the ore is copper-zinc with values in gold and silver; and in the Slocan and other areas in British Columbia, where the ores are silver-lead-zinc.

The development of so many new properties is mainly the result of improved methods of concentration and metallurgical treatment, due to the enterprise of the operators and, in many instances, to the co-operation of the Dominion Department of Mines. The total milling capacity for the treatment of lead, lead-zinc and copper-zinc ores is at present about 12,000 tons a day, and enough ore has been blocked out at various mines in the country to permit of the actual output of lead and zinc being doubled, should market conditions justify such an increase.

Great activity was noticeable in 1928 in all the producing centres of British Columbia. Plant extentions, remodelling, and the construction of new mills during 1927 and 1928 contributed to the large increase in production for 1928. New mills have been constructed at the Paradise mine, Wilmer, East Kootenay; at the Whitewater and the Lucky Jim mines, near Zincton; at the Noble Five mine, Sandon; and remodelling of plant effected at the Ruth Hope mine, Sandon, and the Hewitt mine, Silverton. At the Sullivan mine, Kimberley, the capacity of the concentrator has been increased from 4,000 to 6,000 tons of ore per day.

The increase in the production of lead and zinc from British Columbia mines has been followed by proportional extensions at the metallurgical plant of the Consolidated Mining and Smelting Company at Trail, British Columbia, which now has a daily capacity of 500 tons of unrefined lead bullion, 400 tons of refined lead and 375 tons of bar zinc. With the exception of the ores produced in Quebec, which are exported for treatment, the entire Canadian output of zinc is treated at the Consolidated Mining and Smelting Company's refinery.

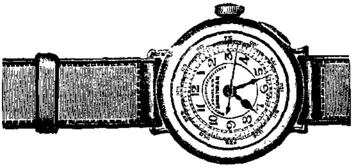
The latest report of the Dominion Bureau of Statistics gives the production of lead by provinces in 1928 as follows: British Columbia, 159,000 tons, mostly derived from the Sullivan mine; Quebec 8,000 tons, obtained from the zinc-lead property at Notre-Dame-des-Anges; Ontario 3,400 tons, derived mostly from the Galetta lead mine and including a small production from the Errington zinc-copper-lead property near Sudbury; Yukon Territory 3,600 tons from the Mayo silver-lead properties. Production for the first six months of 1929 was 78,055 tons. The world's production for the same period was 958,700 tons.

During the last few years Canada has been exporting large quantities of pig and refined lead, and these exports reached 125,000 tons in 1928. In the same year, the Canadian consumption of lead amounted to 37,000 tons. Relatively small quantities of lead ores and concentrates are exported from Quebec and the Yukon where smelting facilities are still lacking.

The production of zinc in Canada was first recorded in 1898 and was obtained from Quebec. Regular production from this province started in 1918 and has increased to 10,500 tons in 1928. The Ontario output

Arnold's New Model Wrist Watch.

Arnold's No. 1 a Gent's Stop Watch, centre seconds Wrist Watches, ditto d tto as No. 1. Stop Watch guaranteed 12 months 10/6. Complete with Strap 7/6.



ANOTHER USEFUL WATCH FOR CHEMISTS.

Another distinctive Watch just placed on the market is Arnold's Appointment Watch, the special feature of which is the fact that it may be set to ring an alarm at any stated time, to give notice, for example, that an appointment is due or that a specified period for some special manipulation has elapsed. The alarm mechanism may, of course, be put out of action, when the instrument is merely in use as an ordinary timekeeper, At one winding the watch mechanism is set for thirty hours, and simultaneously the alarm mechanism for a single operation only, so that rewinding is needed for each appointment indicated. The rear cover of the watch is made to open backwards and forms a stand so that the watch will stand conveniently on a desk when so desired, and like all the other Stop Watches and Chronographs mentioned, has a lever movement, of three years guarantee, whilst the price is very inexpensive, only being 25s.

All and each Arnold Watch is distinguished by its perfection, quality of material, and exclusive workmanship. Quality has in fact been the dominating characteristic of the Company's products throughout its history of many years' standing, and upon its merit has built a trade.

MATTER AND LOGIC.

By DR. W. TOMBROCK.

In my last article and perhaps in previous ones also our conception of the proton was described as *new*.

This latter is incorrect, which is not surprising in view of the fundamental character of our discussions; this conception is *not* new,

We have recently found in Mendeléeff, *An Attempt towards a Chemical Conception of the Ether*, 1904, Longmans, Green & Co., p. 5 : " . . . *it will suffice to mention the* fact that the atoms of modern science have often been explained by *vortex rings*, that there was formerly a strong inclination to conceive the chemical atoms as built up of themselves, or of a ' primary matter,' . . . . "

Mendeléeff wrote this in 1902. It thus appears that others have formerly been much inclined towards this conception, which is also ours. This does not naturally detract from the plausibility of this conception, which we consider as our fundamental hypothesis; I would rather say on the contrary, the fact that several thinkers arrive at the same solution, is a strong argument for the probable correctness thereof. That we, so to speak, re-discovered the conception more than a quarter of a century later, shows, however, that it has obtained no general and lasting recognition. Why not? We may, however, point out and emphasise it in so doing that this conception is now found in the frame-work of new data and changed physical ideas and views, which were not yet known or current before 1902 . . . and which are strong arguments in favour of our conception. We return to this in its time and at the same time call special attention to the fact that a new discovery of a conception, particularly when this is supported by means of new arguments, points to the possibility that this conception may be something more than merely an hypothesis, in other words, under the changed conditions (further data) may have become a *logical postulate*.

Bergen op Zoom,
Holland.
December, 1929.

ALL-BRITISH SAFETY INVENTION.

THE McLUCKIE GAS DETECTOR.

The patenting of the McLuckie Gas Detector is an important step towards human safety in many branches of industry as it enables any person of average intelligence to detect and measure accurately the presence of any known combustible substance in the atmosphere.

Sir Humphrey Davy's discovery of the flame safety lamp provided the colliery manager with a reliable means for the detection of fire-damp, but the amount present could not be estimated accurately and since then, numerous attempts and much research have been carried out in this and other countries, to evolve a simple apparatus to detect and measure accurately on the spot the presence of fire-damp in mine air.

The Coal Mines Act of 1911 specified definite maximum percentages of firedamp such as ¼ per cent. in main in-take airway; ½ per cent. in return airways used for haulage; 1¼ per cent wherever electrical machinery is in use; 1¼ per cent. for the withdrawal of men in naked light pits; 2½ per cent. for the withdrawal of men in the safety lamp pits, etc.

The difficulty of measuring accurately the above percentages with flame safety lamps is admitted by all practical men, and the advantages of devices that could be used underground with safety have been responsible for the production of various types of detectors of varying degrees of accuracy.

THE RESULT OF FIVE YEARS OF RESEARCH.

After five years' research work it has been found and proved to the satisfaction of Messrs. Naylor, Ltd., that the only reliable principle that could be adopted was that of the combustion equation of CH_4 in air. Searching tests carried out under every possible mining condition have confirmed this. This principle is used in the McLuckie Gas Detector.

In the case of methane the combustion equation is :—

$$CH_4 + 2O_2 = CO_2 + 2H_2O.$$

One volume of methane when burned, produces two volumes of steam. The steam condenses and produces a reduction in pressure. This reduction in pressure is directly proportional to the amount of methane burned.

The McLuckie Detector puts this principle into action by—

(a) Combustion chamber, made of copper, containing a spiral of platinum wire heated electrically. This chamber can be connected to a U-tube gauge by means of a gunmetal tap.

(b) U-tube gauge containing liquid and graduated to read directly in percentages of firedamp.

(c) Compensating chamber made of copper and connected to the other limb of the U-glass tube.

(d) Two volt accumulator.

(e) Switch to complete the circuit between the accumulator and the platinum spiral.

(f) Control tap which will (1) connect both chambers to the atmosphere, in which position the sample for test is introduced into the combustion chamber by means of a rubber bulb; (2) will completely seal both chambers from air and the U-tube; the combustion of the sample and the condensation of steam is effected with the tap in this position; (3) will connect the graduated limb of the U-tube to the combustion chamber and the other limb to the compensating chamber.

ANYONE CAN USE IT.

The simplicity of control and operation is such that any person of average intelligence can be trusted with this device. A single control handle brings the tap to all positions and a push-pull switch completes the circuit between the platinum wire and the accumulator. The position of the switch is such that the circuit cannot be completed when the combustion chamber is open to the atmosphere.

The U-glass tube is protected by means of a metal guard and plate glass. The scale is very open with a space of 1″ to 1 per cent. of methane and is calibrated in tenths of 1 per cent., so that even 1-20th of 1 per cent. can be easily detected and measured accurately.

The device is enclosed in a solid cast aluminium case with removable back provided with machines flanges. It is held in position with eight bolts and locks with lead rivets in the manner of a safety lamp. Every part is of robust construction and there is nothing to go wrong. The total weight is 8¾ lbs., and the measurement 14″ high, 4½″ wide, and 4″ deep.

Safety is absolute. Tests have been carried out in explosive atmospheres repeatedly and there is no fear whatever of causing an ignition or exposion.

ABSOLUTE ACCURACY.

So far as accuracy is concerned, samples of methane and air prepared by analysis and varying from 1-20th of 1 per cent. to 3 per cent. were used repeatedly in their normal state, then dried and also moistened. In every case the readings obtained were

accurate and corresponded with the analysis. The detector is uanffected by the surrounding atmosphere and tests carried out in a room heated to 70 degrees Fahrenheit and in temperatures below freezing point were also accurate and corresponded with analysis.

The device has been fully tested by the Mines Department at their Testing Station at Sheffield for accuracy from zero to 3 per cent, for safety in inflammable atmospheres and also at a number of collieries to prove suitability for use underground. It is now certified safe and accurate and is approved for use underground. The systematic testing of air for firedamp, particularly at the coal face affords a most perfect means of ventilation control.

There are cases where the detector is useful at the surface in office or laboratory. In such cases, the rubber bulb is not used. The samples are collected underground in sampling bottles with rubber stoppers. Such sampling bottles, when brought to the laboratory, are held neck under water to remove the rubber stopper. This is replaced with another stopper of the same size, but fitted with funnel, tap and connecting tube. It is an easy matter to introduce the sample into the combustion chamber by water displacement.

It takes six minutes to carry out a test carefully; at the end of this time a clear reading is shown on the U-glass tube. The control handle is then turned back to its original position, and everything is ready for further tests. No calculations, no cleaning out, nothing to go wrong and no cost of upkeep beyond the re-charging of a small accumulator which is sufficient for 60 tests.

Utility for All Sorts of Undertakings.

The coal mine is not the only place where dangerous gases are present. The public will remember too well the recent explosions in London streets.

Various gases such as sewer gas, petrol fumes, coal gas, collect in the main ways and tunnels until they reach the danger point and the slightest mishap ignites them, and loss of life and capital follow.

To gas works this new detector is invaluable in the evacuation of containers. Leakages in excavations and buildings need watching carefully, and a device that can be used by any person of average intelligence is of great value.

In petrol refineries and storage places, ships, oil tankers, all industries where petrol and benzine is used in the process of manufacture wherever there is hydro-carbon—in other words, wherever there is gas that is of a combustible nature—the McLuckie detector fills a need, and ensures safety to human life and capital.

Wherever the faintest trace of combustible matter is present, a clear reading can be obtained. The detector is 100 per cent. British, being manufactured by Messrs. J. H. Naylor, Ltd., of Wigan.

ONTARIO MINERAL PRODUCTION.

Large Increase Expected in 1929.

The Hon. Charles McCrea, M.P.P., Minister of Mines of Ontario, in a foreword to the Annual Report of his Department, just issued, states that the mineral production in the Province in 1929 seems likely to reach a total value of $110,000,000. This would represent an increase of 10 per cent. over the 1928 total. Down to the end of September, the production of metals in 1929 was valued at $59,422,878, as compared with $50,675,310 for the corresponding nine months of 1928. The major portion of this increase is due to the rising importance of the nickel-copper industry. If platinum and other precious by-products are included, the total value of the nickel-copper ore produced to the end of September increased by $6,985,077 or 31.2 per cent. over the all-inclusive total for the same period of 1928.

ONTARIO LIGNITE.

Officials of the Ontario Department of Mines expect to be in a position to issue next spring a definite report on the extent of the lignite deposits now being developed in the area lying to the south of James Bay.

Diamond-drilling operations have enabled the officials to estimate that between 20,000,000 and 30,000,000 tons of low-grade coal are available in the deposits. Altogether 21 test holes have been sunk which have shown the field to be from 3 to 4 square miles in extent. The second diamond drill is to be placed in operation shortly, and work during the winter may demonstrate more or less definitely how much further the coal beds extend outside the area already mapped. By next spring it is estimated that 60 test holes will have been sunk. In addition two shafts will be sunk during the winter, and some of the lignite will be taken out in order to enable the authorities to conduct tests, some of which will be carried out by the officials of the Temiskaming and Northern Ontario Railway.

THE PRECISE MEASUREMENT OF X-RAY DOSAGE.

By LAURISTON S. TAYLOR.
(*U.S.A. Bureau of Standards.*)

A comparison of the unit of X-ray dosage was made by Behnken and showed a variation of 4 per cent. between various laboratories. For the purpose of definition and constancy a well controlled direct-current voltage source is provided for the X-ray tube. Using this, a comparison was made between the various methods using the same equipment for all. A large parallel plate ionisation chamber was used to measure the *r* unit as defined by international agreement. The discrepancies were found to be due to the electrostatic field distortion introduced by the various ionisation current measuring devices. For the purpose of measuring *r* precisely a null method is used and described. Sources of error are discussed and their probable magnitude indicated in certain cases. Under known conditions the difference between Behnken's and Glasser's determination has been duplicated in order of magnitude and in direction. A complete description of the Bureau of Standards equipment for the standard measurement of Röntgen dosage is given.

INTERNATIONAL CONGRESS OF MINING, METALLURGY AND APPLIED GEOLOGY.

SIXTH SESSION, LIEGE, 22-28 JUNE, 1930.

Following the decisions at Düsseldorf in 1910, the Sixth Session of the International Congress of Mining, Metallurgy, and Applied Geology will be held at Liége during the International Exhibition of 1930. These meetings will be under the gracious patronage of His Majesty King Albert and under the patronage of the Belgian Government.

The Congress has been organised by the Liége Association of Engineers and the Geological Society of Belgium at Liége, in consultation with the Societies which took part in the Conference at Düsseldorf.

The date of the Congress is 22-28 June, 1930.

The Organising Committee has just published a notice indicating :—

(1) The personnel of the Committee of Honour, the Committee of Patronage, and the General Organising Committee.

(2) The rules of the Congress.

(3) The subjects to be discussed.

(4) The outline programme of excusions and visits to works.

Numerous interesting subjects will be dealt with—mining, metallurgy, non-ferrous alloys, geology, etc.

DEAD SEA POTASH.

REPORTED SUCCESS OF RECENT TESTS.
TWENTY YEARS' WORK.

A new company has been registered to reclaim mineral salts from the Dead Sea. The grant of the concession by the Government is in the final stages and intensive experimental work needed is being carried out on the site.

Dr. S. Van Vriesland said to a special reporter :

" The mineral deposits of the Dead Seea are amongst the richest in the world and the only source of potash in commercial quantities in the British Empire.

" We intend to extract first potash, then bromide, and eventually when adequate transport facilities are provided, it may be possible to extract common salt as a commercial proposition.

" At present everything must be transported from and to the Dead Sea by road and before the work can be fully developed, a railway down the Jordan Valley will be needed.

" The salt water is run into shallow pans and left in the sun to evaporate. This plan will be used when the work is developed, but the pans at present are for experimental purposes only.

" Dr. Novomeysky, who has formed the company, has been working at the Dead Sea for twenty years and the recent tests have been extremely satisfactory.

" The potash will be used largely for fertiliser in Palestine, and the agriculture of the country will undoubtedly be aided considerably when potash is available in quantity."

FIVE HUNDRED TONS OF ASPIRIN A YEAR.

Deaths from poisoning by aspirin (says the *Pharmaceutical Journal*) are on the increase in England and Wales according to the Statistical Review of the Registrar-General. This is not surprising in view of the quantities of the drug (500 tons a year, according to Dr. Dishington) consumed in this country. The significant fact is that there has been a big jump in aspirin fatalities. In 1927 five people met their deaths, by intent or accident, through taking aspirin, while in the year before there was no recorded case. In 1928 the number was seventeen — ten accidents and seven suicides. That there is a moral to be drawn from these figures is obvious.

ISSUES OF CAPITAL IN NOVEMBER.

New capital issues in the United Kingdom continue decidedly on the small side, and, while the total for last month was larger than October's, it was much under that of the corresponding month of last year. For the eleven completed months the aggregate, also, is considerably below last year's.

CANADIAN IRON AND STEEL.

FINAL STATISTICS FOR 1928 JUST ISSUED.

The Dominion Bureau of Statistics at Ottawa has forwarded to the High Commissioner of Canada in London a Report giving final statistics on the Iron and Steel Industry in Canada for 1928. In that year 1,159 plants were in operation which had a total capital investment of $702,931,186 and employed on the average 119,200 persons with a combined output valued at $609,632,999. The value added by manufacturing processes (arrived at by deduction of the cost of materials) was more than $300,000,000.

Imports into Canada during 1928 of iron and steel and their products were valued at $322,959,144, as compared with $248,151,554 in 1927. Over 91 per cent. of the imports in this class came from the United States and about 5 per cent. from the United Kingdom.

Canadian exports of iron and steel in 1928 reached a value of $70,665,677, as against $67,831,374 in 1927. The principal countries to which Canada exported iron and steel goods in 1928 were: United States, $9,216,896; United Kingdom, $8,416,250; Argentina, $6,784,262; Australia, $7,387,236; British India, $6,877,739; New Zealand, $5,421,763; Brazil, $3,162,412; British South Africa, $2,953,139; British East Indies, Chile, Germany and Dutch East Indies over a million dollars each. In addition to the above, foreign produce of iron and steel re-exported from Canada during 1928 was valued at $4,164,254 as compared with $3,113,235 in 1927. Of the year's total $3,952,464 went to the United States and $117,318 to the United Kingdom.

NEW STEEL PROCESS.

According to a recent announcement at Montreal, a syndicate including Messrs. James Playfair, Frank M. Ross and others, has acquired rights to the Musso Semi-Direct Steel Process, and arrangements are stated to have been completed with the Canadian Department of Mines permitting the erection of a pilot plant at the Government's *pyrometallurgical laboratory* at Ottawa for the purpose of demonstrating the process.

This process includes the direct reduction of iron ores to sponge iron by the application of the carbon of coal; magnetic separation of gangue; melting of the sponge iron in the presence of a suitabe flux in order to produce pure iron; and the formation of steel by the addition in a steel furnace either of carbon alone or of carbon and alloy constituents.

THE CANADIAN COAL TRADE.

During the past year, the Canadian coal industry established a new record in output tonnage, the total produced being 17,564,293 tons, or 1 per cent. more than the 1927 output of 17,426,861 tons. Alberta secured a 6 per cent. advance in production, but the Nova Scotia output was 4.7 per cent. lower than in the preceding year. Gains were recorded in the tonnages of lignite and snb-bituminous coal mines during the year, but the output of bituminous coal was slightly less.

SUCESSFUL WHALE CATCH.

A catch of whales producing 90,500 barrels of oil, valued at over £377,000, is reported for the first seven weeks of the 1929 Antartic season, ended December 8, by Anglo-Norwegian Holdings, Ltd., the largest British unit in the whaling industry, for the companies it controls. During the same period last year 61,500 barrels of oil were produced.

THE PRINCE OF WALES AND THE BUENOS AIRES EXHIBITION.

H.R.H. the Prince of Wales has expressed his willingness to become Patron of the British Empire Trade Exhibition which will be held in Buenos Aires from February 18 to April 2, 1931.

Official intimation of the above is given in a letter dated December 10, and addressed to Mr. Follet tHolt, Chairman of the London Executive Committee of the Exhibition. The letter adds that His Royal Highness has no doubt that the Exhibition will be of great benefit to British trade and wishes all success to the enterprise .

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, December 19.

The Influence of Hydrogen and of Water Vapour on the Ignition of Carbon Monoxide. By A. SMITHELLS, H. WHITAKER, AND MISS T. HOLMES.

The experiments described in this paper began at Leeds soon after the publication of an observation made by Bone and Haward in 1921 to the effect that the catalytic influence of hydrogen exceeded that of water vapour in the combination of carbon monoxide with oxygen. It was decided to atteempt to measure the relative effects of hydrogen and water vapour on the initial ignitability by the spark discharge of a carbon monoxide-oxygen mixture. The experiments then begun have, after a long interval, been continued in Prof. H. B. Baker's laboratory at the Imperial College.

To the purified gases mixed in combining proportions and contained in two eudiometers, hydrogen and water vapour were added respectively in equivalent proportions, and after allowing time for admixture a spark was passed simultaneously through each mixture. It appeared in the first instance, when the drying of the gases had not been greatly prolonged, that hydrogen was more effective than water vapour in conferring ignitability. In the experiments carried out through a range of concentrations varying from approximately 0.03 per cent. to 0.06 per cent., hydrogen was effective whilst water vapour was not. An estimation of the minimum quantities necessary was attempted and gave 0.03 per cent. for hydrogen and 0.12 per cent. for water vapour. These figures are not to be taken as absolute values as they are affected by the conditions of the experiments. In later experiments with more intensive drying of the combustible mixture, it was found that the activity of the hydrogen was altogether inhibited. In other words, the superior catalytic effectiveness of hydrogen just described was in its turn conditioned by the presence of a minimal quantity of water vapour. In general these results are in harmony with the observations of other workers.

The Parachor and Chemical Constitution. Part XIV. Tellurium Compounds. By F. H. BURSTALL AND S. SUGDEN.

The parachors of a number of bivalent tellurium compounds have been determined and give an atomic constant Te=79.4. This value lies between the constants for antimony (66.0) and iodine (91.0), and shows a steady increase of atomic parachor with atomic number in the family O=20, S=48.2, Se=62.5, Te=79.4.

Measurements have also been made on two very stable quadrivalent tellurium compounds which give parachors in good agreement with the hypothesis that the molecule contains two singlet linkings. The data of Lowry and Gilbert (*J.*, 1929, 2087) for dialkyltelluride dihalides are also in general agreement with this view. The electronic formulation of the isomerides of this series is discussed.

Studies in Strainless Rings. Part II. The Effect of Trans-*Decalin on the Carbon Tetrahedral Angle.* By K. A. N. RAO.

The neutral and acid products of monobromination of ethyl hydrogen *trans*-decalin-2 : 2-diacetate give on hydrolysis with sodium carbonate the four theoretically possible lactones.

Hydrolysis of the *monobromo-ester* with concentrated potash at 150° gives three *spiro*-acids, two of which are *trans*-, and are both converteed into the same *cis*-acid on distillation and decomposition of the resulting anhydride. The *trans-spiro*-acids are decomposed by 10 per cent. hydrochloric acid at 240° and by 20 per cent. acid at 200°.

The dibromo-ester on hydrolysis with 64 per cent. potash is converted mainly into the keto-acid. A small quantity of the unsaturated acid is also formed and has been identified by comparison with the acid synthesised from *trans*-β-decalone. Methyl-alcoholic potash hydrolyses the dibromo-ester to the methoxy-*spiro*-acid which is converted by boiling hydrobromic acid into the keto-acid, the latter being entirely unaffected by 64 per cent. potash.

The cause of this large difference between *trans*-decalin which is obviously a strainless ring and *cyclo*-hexane in their effects on the carbon tetrahedral angle is discussed.

Synthesis of l-2-thiol-histidine. By J. N. ASHLEY AND C. R. HARINGTON.

l-Histidine methyl ester was converted by benzoyl chloride and sodium carbonate into methyl - $\Delta\gamma$ - $\alpha\gamma\delta$ - tribenzamidopentenoate, and this, by hydrolysis with methyl alcoholic hydrogen chloride, into methyl $\alpha\delta$-dibenzamido-γ-ketovalerate (cf. Windaus, Dörries, and Jensen, *Ber.*, 1921, LIV, 2754). On further hydrolysis with concentrated hydrochloric acid, this yielded the dihydrochloride of $\alpha\delta$-diamino-γ-ketovaleric acid.

A concentrated aqueous solution of the latter was heated at 100° with one molecular equivalent of sodium thiocyanate, and, on adding sodium acetate to the reaction mixture, the amino-acid was obtained in crystalline form.

The constitution of the amino-acid was proved by the fact that on oxidation with ferric chloride it yielded histidine.

2-Thiol-4(5)-β-aminothylglyoxaline (2-thiolhistamine). By F. L. Pyman.

2-Thiolhistamine has been synthesised from αδ-dibenzoylamino-β-ketobutane which Windaus, Dörries, and Jensen (*Ber.*, 1921, LIV, 2745) prepared from the tribenzoylaminobutene resulting from the benzoylation of histamine. On hydrolysing αδ-dibenzoylamino-β-ketobutane with alcoholic hydrochloric acid at 150° *αδ-diamino-β-ketobutane dihydrochloride* was obtained, and on condensing this with 1 molecule of sodium thiocyanate *2-thiolhistamine* resulted. Its constitution follolws from the results of analysis combined with the fact that it yields histamine on oxidation.

SOCIETY OF GLASS TECHNOLOGY.

A meeting was held in the Science Museum, South Kensington, London, S.W.7, on Wednesday, December 18, when the following papers were read :—

The Choice of Annealing Schedule for Commercial Glassware. By J. B. Murgatroyd, B.A.

(A communication from the Laboratory of the British Hartford-Fairmont Syndicate, Ltd., Greenford).

A Theory of the Strength of Thermally Toughened Glass. By Dr. J. T. Littleton, Jr., and Dr. F. W. Preston.

The Strength of Glass Containing Cracks. By Lowell H. Milligan.

(A communication from the Norton Company Research Laboratories, Worcester, Mass., U.S.A.)

NOTICES OF BOOKS.

Reminders for Company Secretaries. By Herbert W. Jordan, Company Registration Agent. Fifteenth Edition. Pp. 66 + xxxii. London : Jordan & Sons, 116-118, Chancery Lane. 1929. Price 2s. 6d.

The coming into operation on 1 November, 1929, of the new Companies Act has necessitated the re-writing of the bulk of this book and its size has been increased by fifty per cent. The new Act is an elaborate measure consisting of 385 Sections and 12 Schedules and additional obligations are imposed on every one of the 115,000 companies now in existence, whether it be either a public or private company limited by shares or a company limited by guarantee or an unlimited company. Probably no other Act deals with so large a number of offences or imposes so many penalties for contravention of its provisions. Four offences render offenders liable to a fine of £500, 47 to fines aggregating £5,357, and a further 47 to fines aggregating £586 for every day during which the defaults or contraventions continue. The duties of a Secretary are increased and the holder of the office will in future be liable equally with his directors for penalties in respect of almost all defaults under the Act, relief in respect of former liability to penalty being afforded in but one instance; namely, where there is neglect in holding the Annual Meeting.

Reminders is intended to be a convenient reference to the busy Secretary; it indicates the duties imposed on him by the Act and the nature of the documents that have to be filed with the Registrar of Companies.

PUBLICATIONS RECEIVED.

U. S. Geological Survey.

The Occurrence and Origin of Analcite and Meerschaum Beds in the Green River Formation of Utah, Colorado and Wyoming. By W. H. Bradley. (158-A.)

Problems of the Soft-Water Supply of the Dakota Sandstone. By Oscar E. Meizer (597-C.)

Surface Water Supply of the Sacramento River Basin, Californio, 1895-1927. By H. D. McGlashan. (597-T.) Price 10 cents.

Surface Water Supply of the United States, 1925. By Nathan C. Grover. (611.) Price 50 cents.

Surface Water Supply of the United States, 1925. By Nathan C. Grover. (612.) Price 25 cents.

Geology and Mineral Deposits of South-eastern Alaska. By A. F. Buddington and Theodore Chapin. Bulletin 800. Price 85 cents.

Geology and Coal and Oil Resources of the Hanna and Carbon Basins, Carbon County, Wyoming. By C. E. Dobbin, C. F. Bowen, and H. W. Hoots. Bulletin 804. Price 60 cents.

The Forsyth Coal Field, Rosebud, Treasure, and Big Horn Counties, Montana. By C. E. Dobbin. Bulletin 812-A. Price 20 cents.

U.S. Bureau of Standards.

Floor Sweeps. (R88-29.)

SOUTH AFRICAN DEPARTMENT OF AGRICULTURE.

The Factors of Production in the Citrus Industry for 1926. By Van den Hoek and W. J. Pretorius.

JAPAN.

Guide to the Institute of Physical and Chemical Research, Tokyo.

CORRESPONDENCE.

TAR AND BITUMEN.

(*To the Editor of the* CHEMICAL NEWS.)

Sir,—The dangers of the use of statistics by those who are not expert is proverbial. In this connection I should be glad if you would grant me the courtesy of your space to explain that the statements which have been appearing in letters to the Press and articles to the effect that 187,000 tons of bitumen were imported last year, and 163,000 tons in the first ten months of this year are quite erroneous. For the purposes of the Customs Returns "bitumen" includes Rock Asphalte which contains not more than from 4 to 10 per cent. of bitumen as well as Wurzilite, Gilsonite and Stearine Pitch. These constitute together a very large proportion of the so-called "foreign" bitumen imports. As has been previously pointed out the bitumen trade of the country is approximately 400,000 tons per year excluding exports. Of this 300,000 are British-refined and rather less than 100,000 tons consist of imported bitumen. It must be remembered further that a large proportion of this imported bitumen is for industrial purposes and is supplying a need which cannot be met elsewhere. Of the bitumen used on the roads a proportion in excess of 75 per cent. is British-refined.

Yours, etc.,

CHARLES W. BYGRAVE.

12, Norfolk House Road,
Streatham, S.W.16.

NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

Forthcoming Events.

ROYAL INSTITUTION.

CHRISTMAS LECTURES ADAPTED TO A JUVENILE AUDITORY.

In the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2., at 3 p.m., by S. R. K. Glanville, M.A., on "How Things Were Done in Ancient Egypt."

Saturday, December 28.—"The Elementary Use of Nature."

Tuesday, December 31. — "Making a Home."

Thursday, January 2.—"Building in Stone."

Saturday, January 4, 1930.—"Boats and Furniture."

Tuesday, January 7, 1930.—"The Workshops."

Thursday, January 9, 1930.—"Hieroglyphs."

SOCIETY OF GLASS TECHNOLOGY.

London Section.

The attention of members is directed to the first meeting of the London Section in the New Year, to be held in the Science Museum, South Kensington, London, S.W.7., on Wednesday, January 8, 1930, at 7 p.m.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

36,545.—Imperial Chemical Industries, Ltd.—Manufacture of nitrocellulose products. November 28.

36,676, 36,677.—Imperial Chemical Industries, Ltd.—Destructive hydrogenation of carbonaceous materials. November 29.

Specifications Published.

322,005.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges) — Manufacture and production of sulphonic acids.

322,008.—Imray, O. Y. (I. G. Farbenindustrie Akt.-Ges.)—Manufacture of vat-dyestuffs of the anthraquinone series.

322,036.—Imperial Chemical Industries, Ltd., Gibson, W., Henshaw, C. R., and Payman, J. B.—Manufacture of triaryl phosphates.

322,037.—Imperial Chemical Industries, Ltd., Gibson, W., and Payman, J. B. — Manufacture of monoalkyl ethers of ethylene glycol.

Abstract Published.

320,345.—Dyes.—Imperial Chemical Industries, Ltd., Millbank, London, Coulthard, A., and Rodd, E. H., Crumpsall Vale Chemical Works, Blackley, Manchester.

Xanthene dyes are obtained by condensing 3.7-tetraalkyl diaminoxanthones with secondary or tertiary aromatic amines having a free p-position to the amino group with the aid of phosphoryl chloride phosphorus chlorides, or carbonyl chloride or other reagent capable of replacing the ketonic group by halogen. Basic dyes containing three substituted amino groups are obtained and may be sulphonated to give acid dyes. In examples 3.7-tetramethyl diaminoxanthone is condensed with a-ethylnaphthylamine in the presence of phosphoryl chloride. The product dyes tannin-mordanted cotton, wool and acetate silk bright magenta shades. The dye obtained from the corresponding tetraethyl homologue gives a brighter and bluer shade on acetate silk. The condensation product from 3.7-tetramethyldiaminoxanthone and *p*-tolyl-*m*-phenetidine is sulphonated in oleum. The product dyes wool in red-violet shades. Examples also illustrate the dyeing of tannin-mordanted cotton, wool, and acetate silk by these products. Specification 314,825 is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His

REGENIT.

504,847.—A chemical preparation for hardening and ennobling metals and alloys.—Charles Rowlet, 15, St. James's Place, London, S.W.1.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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